GOVT. BOTANIC GARDENS
LAL-BAGH, BANGALORE.
LIBRARY
No. 127 Date 11.7.71

THE

GARDENS' BULLETIN,

STRAITS SETTLEMENTS.

INTO WHICH IS INCORPORATED ALL THAT HAS BEEN PUBLISHED AS THE THIRD SERIES OF THE AGRICULTURAL BULLETIN OF STRAITS AND FEDERATED MALAY STATES.

The Gardens' Bulletin will be published as material becomes available. Its price is fifty cents a copy, post free, or in advance for a volume of twelve numbers, post free,

Five dollars in the Straits and Federated Malay States

Nine and a half rupees in India and Ceylon,

Thirteen shillings in Europe.

Subscriptions paid to the third series of the Agricultural Bulletin, Straits and F. M. S. are counted as subscriptions to it.

GOVT. BOTANIC GARDENS
LAL-BAGH, BANGALORE.
LIBRARY
No. Date.

SINGAPORE:
THE STRAITS TIMES PRESS, LIMITED.

THE

GARDENS' BULLETIN,

STRAITS SETTLEMENTS.

Vol. I. Issued December 15, 1913. No. 6.

EDITOR'S NOTE.

Since 1891 the Botanic Gardens have had a publication; at first it was an occasional publication, then in 1902 it became a monthly, by a joint agreement with the Governments of the Straits Settlements, and Federated Malay States and the United Planters' Association of Malaya. Now, again, the period of the agreement having terminated, it will be occasional.

The price for each issue and for each volume remains as hitherto; but the title has been changed in order to avoid confusion with the Agricultural Bulletin of the Federated Malay States. It is thought that the title "Gardens' Bulletin, Straits Settlements" is satisfactorily descriptive, distinctive and conveniently short. The five parts published as the third series of the Agricultural Bulletin, Straits and Federated Malay States, become the first five parts of the Gardens' Bulletin.

As to our aims and the scope of the publication, this number gives a fair representation. There will be more original matter within the cover than formerly, but no market reports and no proceedings of meetings. Illustrations will be inserted where required.

Our readers will understand that, if for each fifty cents we give more original work than formerly, we cannot go to press with the same frequency, as we did. Subscriptions paid to the first volume of the Third Series of the Agricultural Bulletin, entitle the payers to this and six more parts of the Gardens' Bulletin.

THE COCONUT BEETLES,

Oryctes rhinoceros and Rhynchophorus ferrugineus.

The Coconut Trees Preservation Ordinance, No. IV of 1890, declares that it is the duty of the owner or person is charge of a coconut tree, dead or attacked by either of the two common coconut beetles to uproot the tree, to burn or to bury it in the ground at a depth of not less than three feet or to submerge it.

The Ordinance and the Amendment, Ordinance No. IX of 1895, give powers to certain inspecting officers to order that this duty be carried out.

A great improvement in the condition of the coconut trees of Singapore was recorded as the result of the enforcing of the Act But now, time having obscured the difference between the former state of the beetle-attacked plantations and their improved condition, it has become a not uncommon thing for plantation-owners to claim that the stumps are not dangerous, and sometimes the order to remove them is met by a grumble that the cost is heavy. In consequence of this, a little reminder of the necessity of removing the stumps appears desirable; and in the following paragraphs with a view to removing misapprehensions it is shown what part they play in furnishing a breeding ground for the common Rhinoceros beetle, and how this beetle prepares the breeding ground for the more destructive Palm-weevil.

The cheapest way of removing accumulations of stumps known to the writer is by the use of explosives. Before recommending it, experiments were tried in Singapore which may be at once briefly described: the experiments were done by Mr. MacQueen, Agent for Messrs. Nobel's Explosives Company, Ltd., in the presence of the writer.

For the purpose in the first instance a row of living stumps was chosen,—stumps of trees newly felled under the Municipal Act: the wood was hard and healthy, and the utmost possible resistance was to be expected. To prepare a place for the explosive, a hole was drilled into each stump on the ground level passing a little beyond the centre, and into this hole the charge was put, and exploded. In the second instance standing dead trees were taken and similarly prepared, charged and the charge exploded. These were the results:—

four cartridges of blasting gelatine, properly placed in the base of a stump, and exploded, blew it so much to pieces that it was not necessary even to pick up the pieces,

four cartridges of blasting gelatine similarly placed in the base of a standing dead tree, and exploded, brought it down leaving in the ground insufficient to serve as a breeding place for the Rhinoceros beetle, and freeing the trunk so that it could be removed easily,

four cartridges of gelignite did not suffice to do the work thoroughly,

three cartridges of blasting gelatine were not quite sufficient.

The cost of thus disposing of coconut trees that have to be removed, amounts to about half of what it costs to fell and subsequently to remove the stump by tediously digging it out. The two operations can be done in one, for the hole for the charge should be drilled in the standing tree and the trunk brought down by the destruction of the butt end.

The two beetles legislated against in the Straits Settlements are *Oryctes rhinoceros*—the Rhinoceros beetle and *Rhynchophorus ferrugineus*, the Palm-weevil. The first is the commoner but individually the less destructive. It feeds as an adult insect in the stems of living palms, generally coconut palms, tunnelling into the softer parts of the stem ; and it sometimes lays its eggs in these tunnels, but for the most part it deposits them in decaying vegetable matter, sawdust, rotting grass, old rotting thatch, wood which is soft enough, especially the central parts of dead palm trunks, and as decay loosens the bark, in the layer of tissue along the line where it and the wood unite. It has been recorded as breeding even in rich vegetable mould. It demands besides the decaying vegetable food, a considerable amount of moisture. As it may happen that the tunnel made by the mature insect in the apex of a palm tree collects rain water and rot is set up, so even if these tunnels are not at first suitable places for egg-laying, they are liable to become so after a short time.

The Palm-weevil lays its eggs on the coconut trees, making for each egg a small hole with its long characteristic snout, then turning round and depositing it to the best of its ability in the hole. The burrows of the Rhinoceros beetle give the Palm-weevil access to the inside of the palm, and full advantage is taken of them, eggs being deposited in or on their walls in preference to any other spot about the palm tree. The eggs give rise to greedy fat white grubs, which eat out galleries through the softest tissue, thereby doing the maximum amount of damage, for they destroy the heart of the palm-cabbage. On the other hand without the aid of the Rhinoceros beetle, they start life in superficial rather hard tissue, at a disadvantage and somewhat exposed to enemies.

The Rhinoceros beetle is a common insect from India to the Philippine Islands wherever large palms abound. In Africa its place is taken by *Oryctes monoceros* and *O. boas*, which attack palms in exactly the same way as *O. rhinoceros*. In Madagascar six other species of palm-attacking Oryctes live. In the Island of Reunion there are two species. Tropical America has a closely allied genus—*Strategus*—which furnishes at least one species of similar habits. Allied genera—*Pimelopus* and *Scapanes* in New Guinea, *Camelonotus* in America—attack young palms burrowing into their stems from the ground.

The Palm-weevil of Asia occurs in India, Ceylon and eastward to the Philippine Islands.

It is replaced by *Rhynchophorus phoenicis* in tropical Africa, by the allied *R. palmarum* in Tropical America and also by the smaller *R. cruentatus*. The latter seems to have a predilection for certain palms of small growth, less perhaps on account of their physical nature than its habit of flying low in the moistest air near the ground. Another similar weevil—*Rhabdocnemis obscura*—destructive to sugar cane in the Pacific islands has been found there in coconut palms.

In 1910 or perhaps one year earlier, a mischance took the Rhinoceros beetle to Samoa. It is believed that a consignment of rubber stumps from Ceylon actually carried it thither. Its presence was first noticed on November 4th, 1910, by reason of damage done to coconut palms growing close to the Customs House of Apia. From Apia it spread widely, chiefly in the direction of the prevailing wind, crossing the island of Upolu, from Apia on the north and passing westwards, but not passing so much eastwards. From the island of Upolu the beetle has flown across the strait dividing Upolu from the island of Savaii. Fears that it might reach Fiji have caused legislation to be brought in preventing the importation from the Samoan islands of anything which might carry its eggs or grubs or pupæ.

Against the pest in the Samoan islands the Government has taken energetic measures, a knowledge of which may be useful to us. Much may be learned from the two papers on it, which have appeared in Der Tropenpflanzer and from one in the Bulletin of the Department of Agriculture, Fiji.*

The first paper was by Dr. Gehrmann, an officer of the Government of Samoa, then in charge of measures against the coconut crab. He described how the mature beetle tunnels for the sake of food into the cabbage of the palm and may kill it: "the loss of palms,.... attribute to Heart-rot and to lightning" had in his opinion, he said, "during the preceeding year been due in chief measure to the beetle."

The second paper was by Mr. F. J. Jepson, Government Entomologist in Fiji, who was sent to Samoa in April, 1912, to ascertain the seriousness of the pest, lest it should be introduccd into Fiji.

The third paper is by Dr. K. Friederichs, the Government Officer who now has charge of the operations against the beetle, and like the first was published in the Tropenpflanzer.

Jepson gave a map showing the area in Upolu, over which the beetle had spread in April, 1912. Friederichs has published another map bringing our information up to date and graphically showing that in spite of the strenuous measures which have been taken the pest is spreading. Since Jepson wrote it has passed over to the island of Savaii; this required the crossing of nine miles of sea; but

*Gehrmann, in Der Tropenpflanzer, xv. (1911) pp. 92, Friederichs, K., in the same, xvii. (1913) p.p. 538. Jepson, F.J., Bulletin, No. 3, Department of Agriculture, Fiji, (1912).

the strait has two islets in it, whereby the widest interspace is reduced to five miles; yet as on Savaii the beetle appeared in three villages, it is just to infer that more than one female insect had crossed the strait, and that with the wind helping, the flight can be at least five miles. However, abundant evidence shows that it is generally much less, the insect seeking a palm tree to feed in, and finding it usually near to its birth place.

As to the extent of the damage done by the beetle about the beginning of 1912, an official statement was made that one hundred and fifty trees had then been destroyed and six to eight thousand, or one-fifth of the others in the affected districts had received damage enough to put their yielding back one or two years. In April of that year, Jepson stated that about Apia and Saleimoa—the worst localities—75 per cent. of the coconut palms showed signs of attack, 30 per cent. had had their yield reduced to a great or small extent, and 1 to 2 per cent. had been killed (some doubtless by the excessive zeal of the natives in their cutting out of the beetles from the crowns). In other districts 25 per cent. of the trees had been attacked and 10 per cent. had had their yield set back.

The measures taken to cope with the beetle have been as follows. On the eighth of November, 1910, the Government of Samoa issued a proclamation in vernacular to the effect that the beetles and their grubs should be collected and promising a reward of one mark (36 cents) for every twenty beetles and the same for every fifty grubs. Seventeen days later a law was promulgated stopping coconut planting, ordering the cleaning up of all existing plantations, forbidding the using of coconut trunks for bridges and pig-styes, and arranging for inspections. About £2,000 was the cost of this method of dealing with the pest up to the end of January, 1912, and yet no satisfactory impression had been made on its numbers. Therefore on the first of February, 1912, it was made compulsory to search for and destroy the insect. Following this there was issued on April 19th, 1912, a decree calling into being a commission with powers to inspect and compel owners of coconuts to keep their estates clean, and to remove structures made of coconut trunks, or standing dead trees at the owner's expense. Then on the 10th of May, 1912, appeared an order requiring all able-bodied persons in the affected districts to turn out at six o'clock on every Wednesday to search for beetles and grubs which were to be brought to the village headmen, counted and destroyed by fire or hot water. Into this great holocaust passed the grubs of beetles which happen to be similar to those of Oryctes. Friederichs names them specifically; but their number is a matter for estimation. From the 1st of April, 1912, to the 31st of March, 1913, roughly, ten million grubs and a quarter of a million beetles were collected and killed on the island of Upolu; allowing for the grubs of the similar beetles, Friederichs puts down the Oryctes larvæ destroyed as six million and the beetles as two hundred thousand—a nice little family originating in a few grubs imported in 1910 or possibly 1909.

To this figure has yet to be added the number of the grubs and beetles collected on the European Plantations. On the estate of the Deutsche Handels- und Plantagen- Gesellschaft der Sudsee-Inseln zu Hamburg over the same period were collected and destroyed about 350,000 grubs and 23,200 beetles. Further the number of insects trapped by the Commission over the same period was 180,000 eggs, 776,000 grubs, 220 pupæ and 11,300 beetles. The traps will be described next.

For the making of a trap a hole is dug in the ground from nine to twelve feet square, and about two and a half feet deep. Rotten coconut stumps, plantain stems, and soil are put into it; and over the top large leaves such as coconut leaves, breadfruit leaves, and plantain leaves are placed rising perhaps a foot above the surface of the soil. Into these pits the female beetles penetrate to lay eggs and the male beetles to find the females. What beyond digging the traps is necessary is that they should be opened at regular and a not too distant periods, or that the beetles in them may be in some way killed.

At distances of about one hundred yards along some of the roads in Samoa these traps have made in series, and on the plantation of the Deutsche Handels- und Plantagen- Gesellschaft there is one trap to every hundred standing trees.

On the latter estate the traps are opened every six weeks or two months.

Jepson states that it takes six men about two and a half hours to open and remake one trap; therefore six men can attend to four traps only per diem, or in rotation 160 to 200. He suggested that the traps might be treated with bi-sulphide of carbon and not unpacked at all. Six ounces of carbon bi-sulphide were accordingly injected into a full sized trap, which after an interval of twenty-four hours was opened. Then all the larvæ in the trap—450 in number—were found dead; three mature beetles were partially asphyxiated, but recovered; rats and mice were found dead. The trap was remade, and re-examined eighteen days later, when to that officer's satisfaction it was found to be again full of beetles, showing that the treatment did not destroy its usefullness, but rather increased it, as a record catch was made. A second trap treated with nine ounces of carbon bi-sulphide at the same time, but opened thirty six hours later, contained 249 dead grubs and one dead beetle.

Unfortunately the German officers discovered that the cost of carbon bi-sulphide in Samoa is too high to make the method worth adopting. The building of traps, however, is a useful proceeding so long as the organisation for inspecting them is efficient; for as we saw above by their means in 1912 the Commission collected 180,000 eggs, 776,000 grubs, 220 pupæ and 11,300 beetles.

Friederichs further gives the following figures to show that the traps are efficient for catching the male insects as well as the female:—out of 1,000 insects taken, 566 were females and 434 males.

Of the lessons to be learned from this Samoa outbreak, the outstanding one is that the beetle is enormously prolific when unchecked. Regretfully we learn too that man cannot keep it down, for it has gained ground in spite of strenuous direct efforts against it; it ought probably to be attacked through its natural enemies—parasitic ichneumon flies and Tachinid flies. These, however, will never serve instead of cleanliness about the plantations and the removal of that in which the grubs prefer to mature.

In German East Africa the method of collecting the grubs and beetles by paying so much for them was adopted some years ago.

It seems that there planters had put out coconuts on virgin forest soil which was full of grubs living in rotten wood in or on the soil, and so they had courted the beetle. At any rate its abundance alarmed them and rewards were offered for the collection of the grubs and beetles. Preuss (Der Tropenpflanzer, xv. 1911, p. 73), says that in October, 1899, on the Muea Plantation of the German East Africa Company 140,000 were taken from the ground at a fixed sum; . . . in Dar-es-Salam in June, 1907, as the result of an offer of a sum for each grub . . . there was a grub-fever among the natives and within a few days 25,000 to 30,000 were collected and destroyed.

In the region of the natural distribution of the Rhinoceros beetle, viz, India to the Philippine islands, a not inconsiderable amount of attention has lately been directed to the damage done by it in various quarters, not so much because of any outbreaks as because Economic Entomology has come to the front. Messrs. J. McKenna and K. D. Shroff do indeed claim that it has lately invaded Tenasserim (Bulletin No. 4 of the Department of Agriculture, Burma, 1910, p. 3), but it is hard to believe that this should have been the case; rather is it more likely that the increase of industries which leave vegetable refuse about, such as saw milling, are responsible for an increase in the numbers of the insect. This might particularly be the case about Rangoon, where it was said that so abundant had the beetle become in, and from 1907 that the very existence of palms in the neighbourhood was threatened.

The laying out of new coconut plantations in Ceylon by European planters brought the beetle to notice through the colony, but especially in the Batticaloa District, where the new plantations chiefly were: and 1903 saw an agitation for legislation against those who allow it to mature.

In the Philippine islands at the other end of the insects limit American enterprise brought to bear on the backward agriculture, turned the light on to it; and of the coconut groves, heavily grassed over and full of fruitless trees, Mr. C. S. Banks said, in 1906, that he found scarcely a tree not marked by its ravages.

From the latter's pen and from that of Mr. C. C. Ghosh, Assistant to the Imperial Entomologist, Agricultural Research Institute, Pusa, India, have come new studies of the life history and manner of working of the insect.

The insect is too familiar to need any description, but there are still several points in its life history, whose obscurity will be brought out by the following paragraphs.

The mature beetle is noctural, generally shunning light and very anxious to hide when exposed to daylight. Ridley (Report on the Destruction of Coconut Palms by Beetles, Journ. Asiatic Society, Straits Branch, No. 20, 1889) says that the insects may be attracted to fires lit in the plantations by night; and Ghose states that they fly to light in Behar, in the Ganges valley, and suggests that they may be trapped by light traps; but others have concluded that lights have not influence enough on the beetle to be worth using. At night both sexes fly abroad in search of food and in search of each other. By preference they do not fly far. Both sexes for the purpose of feeding alight in the tops of coconut palms and other palms†; there they seek the softest spots and commence to burrow with their powerful mandibles. After half an hour's work they are about one quarter of an inch into the tissues; at dawn they have penetrated at least more than their own considerable body-length. Young palms, which are growing fast and so expose a greater length of rather soft tissue than do the old palms are on this account more exposed to attack; perhaps also, they are more attacked because their soft parts lie in the still damp air near the ground, whence the beetle may have emerged and whither, if female, it probably will go to lay eggs. The beetle chews the tissues as it burrows swallowing the juice but ejecting from its jaws the fibrous parts. At first it burrows chiefly for the sake of a lair, but as it wants fresh food throughout its life, it continues its tunnel to feed. It is a matter of chance in what direction the tunnel goes; if by chance it reaches to the centre of the growing apex of the stem, the tree is killed; again if the hole so lies open that rain water gets into it rot sets in and again the tree is killed. But fortunately for the most part the beetle finds food enough in the young leaves enwrapping the apical bud, and by boring transversely through these, tangentially to the apical bud, cuts them while folded so that on emerging from the bud they appear as trimmed,

† The following palms are recorded as attacked by the Rhinoceros beetle :—

Cocos nucifera—the Coconut, *Cocos plumosa*, *Martinezia caryotæfolia*, *Phœnix dactylifera*—the Date palm, *Phœnix sylvestris*, *Livistona chinensis*, *Verschaffeltia splendida*, *Dictyosperma album*, *Hyophorbe amaricaulis*, *Elaeis guineensis*—the African oil palm, *Corypha umbraculifera*—the Talipot palm, *Corypha Gebanga*, *Borassus flabelliformis*.

topped, or belted. The damage so done can be measured in the proportion of leaf tissue cut off; in severe cases it amounts to a set back of one year. Rarely does the insect directly kill the tree; but we do not know how often. In Malaya it is certainly common to ascribe to lightning the work of the Rhinoceros beetle.*

The beetle must be attracted to the trees by some chemical substance; and it has been suggested that this is to be found in the odour of the sap, but Friederichs experimented with palm toddy fermented and fresh, and did not take a single beetle thereby. The observation is curious, for it is known that attacked trees may become favourite trees and one boring is followed by another. However, as Friederichs found that the sex odour of the beetles is attractive, we perhaps find an explanation for the repeated attentions of the beetles to one tree in the attraction of a beetle for more individuals of the other sex than one, and the surplus insects being unwelcome in the mating burrow, excavate one of their own in the same tree top.

The beetles of course find some attraction in the decayed material which they seek for egg-laying. Friederichs combining the attraction of rotten cocoa husks with the smell of a large number of imprisoned beetles of both sexes, and placing a light over the cage caught in eight nights ten females and twelve males which were attracted. The catch seems small, and as he remarks hardly worth making.

It is certainly no odour of the flowers, which attracts the beetles, for long before flowering they are attacked; and a writer in the Tropical Agriculturist (Beven, on p. 111 of N.S. vol. xxiv., May, 1905) says that the king coconut is particularly liable to attack in the alternate years between flowering.

The beetles mate in the holes that they make, but rarely lay eggs in them. The eggs are deposited in decayed vegetation wherever that may be; and it is possible that the undoubted cases of egg-laying within the burrow have been induced by some decay within it. Perhaps the burrower has struck an old hole with decay in its sides; but events which take place in the tops of palms are rather hidden from the eye of man. Let it suffice to say that undoubtedly the female rhinoceros beetle does sometimes lay eggs within the burrows, and that then destruction of the tree follows. The writer knows well that the very first signs of decay in a felled palm top are signals for the appearance of young larvæ from eggs there deposited.

Into the holes penetrate the Palm-weevils to lay eggs, and in giving them access to the soft tissues is the unpardonable crime of the Rhinoceros beetle.

---

* Cf Koningsberger, J. C., Mededeelingen van 'Slands Plantentuin, xxii. (1898) p. 42.

The Rhinoceros beetle probably lives long as a mature insect; but observations are wanting. Without food Ghosh found it to live for three weeks. If dissected, very few eggs can be found in the female at any one time, and Ghosh observed that they are laid, say, three on one day, two on the next, two on the following day, and so on, each egg apart from any other.

But unless this slow egg-laying continues over a long period how could one get the millions of grubs which were collected in Samoa? The eggs, Ghosh found, were laid at night. The grubs hatched out after ten to twelve days, at the beginning of June. On the twentieth of October, grubs from these same eggs appeared to him to be full grown. Where Ghosh worked, a cold dry weather sets-in, in October, and is followed by a hot dry weather lasting until June. Ghosh's beetles made no progress during the cold dry season, though they were not dormant. One beetle only survived it and emerged on the fifth of May, having taken nearly twelve months to complete its cycle.

Yet it seems probable that in warmer damper countries such as the Malay Peninsula, growth is continuous and the life-cycle shortened to fewer moths; if this were not so we should find a greater proportion of large full grown grubs than we do, and the writer has some reason for thinking that six to seven months are enough for the beetle to pass from one generation to another: and again supposing that four grubs were introduced into Samoa in 1909, two of each sex, and that they matured and laid eggs, so large a supply as was present in 1913 requires that each female should have deposited considerably more than two hundred eggs, if the period of one generation be twelve months; but if the period of one generation be six months, fifty-four millions might be reared from two females laying fifty eggs apiece.

The grubs are blind, and very soft-skinned behind the head. Five minutes exposure to sunlight kills them at maturity. They have a breathing apparatus capable of being closed, which is an adaptation for living in almost liquid decaying matter. Their demand for moisture is very great. We can kill them easily by letting them dry, and conversely we can greatly encourage them by supplying to them damp coconut stems. There is a no more mischievous practice than that of lining the banks of a ditch or stream with coconut logs and every such place must be ruthlessly destroyed. The practise of using coconut logs for bridges is only a little less obnoxious, and should be stopped. The leaving of stumps in the ground in dry places through dry weather is not obnoxious; but the leaving of stumps in the ground in wet places and in wet weather is; and as sooner or later wet weather comes on the once dry stump becomes damp enough for the beetle-grubs to grow in it. The necessity for removing such stumps depends on the length of time that they are likely to remain damp enough for the grubs—whether it may be a period approaching their (apparently) six months course of growth or less.

Upright tall dead trunks commonly harbour grubs, for the wood decays faster than the bark and a cup which catches rain is formed just suitable to the beetle.

Now it is not to be thought that the coconut stump is the only one to be removed; the beetle can live in many palms apparently as well as in saw-dust of soft woods of trees that have no relationship to the palms. It can live in manure heaps, and old tan heaps; all such heaps should be turned over (if it is necessary to keep them) at least once within the period of the life time of a grub, viz., six months (which period it were better to reduce to three for safety). In turning over the heaps, grubs exposed to the sun will be killed. Old decaying thatch in which it can live, should not be left to breed the beetle. When full fed the grub makes for itself a case in varying fashion; it seems as if it took to rotation and when lying in fibrous material thereby arranged the fibres more or less concentrically, or if lying in earthy material compacted for itself a wall. In this case it turns to a pupa and from it emerges a mature insect, ready to attack the living palms.

The Palm-weevil—*Rhynchophorus ferrugineus*—also has been studied by Ghosh, at Pusa in the Gangetic plain. He bred it in March, April and May and he found that it passed through a life cycle in about two months. As well as from its more destructive habits as from so rapid a course it is more dangerous as a pest than the Rhinoceros beetle; and when, as there has been recently in Singapore, an outbreak of it occurs, we cannot afford to let three months go by as in the case of the Rhinoceros beetle, but must pay constant attention to the infected spot. It breeds at all seasons, and there is no evidence that the cold weather of the Gangetic plain retards its growth, through there is some evidence that egg-laying may be retarded as is the case with the American Palmetto weevil *Rhynchophorus cruentatus*.*

The mature beetle seeks the tops of the palms chiefly by night, but also by day, and with its long snout makes a small puncture, into which to the best of its ability it places an egg. If entry is to be had to the inside of the palm by a ready-made hole so much the better for the weevil and the worse for the palm; full advantage is taken of all such holes. In a hole, according to Banks, it does without making any appreciable puncture, but pushes the egg into the tissue a little way. The eggs are laid several upon one tree, near together but not in contact, and if laid from the outside, not within one of the Rhinoceros beetle's borings,—are placed ¼ to ¾ inch deep in the tissue, right at the bottom of the puncture. Eggs were laid in Ghosh's laboratory by day as well as by night. One insect deposited 276 eggs in a life time of 49 days, another 127 in 46 days and four kept together 213 in 24 days. The greatest number of eggs laid

*Summers in Canadian Entomogolist, v., p. 123.

by a single female on one day was 32. The grub, like the grub of the Rhinoceros beetle, shuns light and is easily killed by exposure to the sun; it likes much moisture so that the hacking open of stems in which they have been growing and the exposure of them, is a good preliminary operation whenever an attacked palm has to be cleared away. They seek the softest tissues of the palm and therefore the very heart, and if left undisturbed they kill the tree with a certainty which is foreign to the Rhinoceros beetle. They do not need the tissue to be absolutely healthy, but finish their growth in dying palm stems among most obvious decay. At maturity they make a case twisting fibres from the stem round themselves and to reach the fibres they have to approach the outside of the trunk which they do close to some place from which they can emerge. The twisting on the eve of pupation is only an exaggeration of the grubs ordinary movements in progression. The pupa stage lasted, under Ghosh's observations, about 25 days.

The most rapid growth recorded by Ghosh was of one insect which emerged as a perfect beetle, 48 days after the egg was laid; 54 and 56 days were quite common periods.

The palm weevil feeds on other palms as freely as on coconut palms. It is recorded as destroying *Oreodoxa regia*,—the Royal palm, *Borassus flabelliformis*, *Phœnix sylvestris*, and the writer has found it in *Arenga saccharifera* and *Elaeis guineensis*. Such palms require watching as do the coconuts for signs of the presence of the grubs, because outbreaks may commence in them and spread to the coconut palms.

Blanford, in an interesting paper on the American Palm Weevil (Kew Bulletin, 1893, p. 37), refers to a very reasonable belief that the period when that insect became a most serious pest in British Honduras began with the giving over to cultivation of ridges where the *Attalea* palm grew. The Attaleas were felled and left to decay, whereupon the weevils multiplied excessively, and flew when their food on the ridges existed no longer, to the near coconut plantations, doing there very extensive injury.

As in the case of the felling of the *Attalea* palms in Honduras, so now in Malaya during the current vogue of removing coconut palms from among rubber, we have a menace to the coconut plantations. A young coconut, such as is so often cut, affords to the palm weevil a splendid breeding ground; it is nutritious from top to bottom, and the beetle is very prompt to take advantage of it.

This is a fact worth remembering; and experience lately in Singapore Island has shown that double vigilance in coconut tree inspection is required, while land owners, of small means and small knowledge, or it may be wanting in public spirit, continue the felling of coconut palms on their properties.

SUMMARY.

The Rhinoceros beetle, though laying eggs slowly, can multiply with great rapidity and as it in all places seems to kill a few coconut palms, when it is unchecked the amount of destruction done may mount up to something appreciable (upwards of 1—2 per cent. in the worst localities in Samoa); beyond the destruction there is a reduction of the yield in less severely attacked palms. Young palms are more liable to its attacks than old ones, partly because they stand in the still or moist air near the ground where the mature beetle seems chiefly to fly, but more because of the greater length of relatively soft tissue which they offer to attack.

The mature beetle tunnels in palms for the sake of food, making its tunnel a lair; it usually burrows through the enfolded young leaves and does not reach the heart of the cabbage and so does not kill the palm: it probably lives for several months, the female steadily laying eggs throughout the period, but the duration of life and the continuance of egg-laying are matters of conjecture. The beetles, and their grubs, shun day-light: they mate in the feeding tunnels or else in the places where the eggs are laid. They sometimes fly to light at night, but not with sufficient readiness for lights to be used as traps. There is something about a palm attractive to them, but it is not the odour of the drawn sap nor of the flowers. The opposite sexes have an attraction for each other; but the caging of the one to entrap the other is only moderately effective. Eggs are laid in decaying vegetation, and when as sometimes happens they are laid in living coconut stems, it may be that some decay had already been set up in an old wound. The smell of decaying vegetation, particularly of decaying palm stems is very attractive to them and may be used for the making of traps. The eggs hatch in 10-12 days, and the grub seems to require about five months for maturing; then it pupates and remains for a brief time as a pupa, emerging a beetle, it would seem, within seven months of the laying of the egg, unless cold or dry weather delays it.

The grub is very thin-skinned, and requires moist food; it can live in very moist food (slush). Exposure to dry air very rapidly kills it.

The way to attack the insect is to remove its food-supply, for although within the region of its natural distribution there are doubtless parasites and enemies, which do something in the way of keeping its numbers down, we know nothing of them, nor are we likely at present to use them to effect. Where the insect has appeared in excessive numbers, the cause has been man, in most, if not in all cases; usually man by putting an exceptional amount of food in the way of the insect, has given it the means of unduly increasing. It behoves us to keep all vegetable refuse under control both in the plantations and about neighbouring tan-yards, saw-mills and villages, for the beetle is not of restricted flight. Old coconut stumps and trunks

sooner or later become vegetable refuse, which must be removed. Traps such as those described above, are effective in direct proportion to the cleanliness of the area in which they are.

When many stumps have to be removed the cheapest method of destroying them is by the use of explosives.

The Palm-weevil goes through its life-history more rapidly than the Rhinoceros beetle; and it would seem that it should multiply more rapidly, as the female can lay nearly 300 eggs within fifty days, but that it is less in evidence is probably due to the circumstance that it is so much more particular about its food; it may be also that it has more enemies, but this we do not know. In any case it is to be remembered that an outbreak of it would be more rapidly destructive than one of the Rhinoceros beetle.

The female lays her eggs in living palm tissue, taking advantage of wounds, of which the commonest are those made by the Rhinoceros beetle; the mature beetles also feed on the palm tissue. If the female finds no hole in the palm, she makes one for herself, but only ¼ to ¾ inch deep; into it she places one egg; if she finds a Rhinoceros beetle tunnel she pushes eggs into its walls. The nearer to the heart of the tree the eggs are placed, the more serious must the attack be; the heart of the attacked palm is then tunnelled through by the fat greedy grubs, and its top falls over, declaring the presence of the invader only when the damage done is past repair. Though the grubs may not be mature when this happens, they finish their course in the tissues. The eggs may be laid also in palm tissues commencing decay.

Soft decaying palm-tissue should never be left lying about the estates to the advantage of the beetle, neither of coconut palms, nor in a general way of other large palms, for though there are palms in which the tissues hold abundant needle-crystals, until a palm, whatever it be, has been proved unpalatable to the grubs, it should be looked upon as possible food for the weevil.

I. H. BURKILL.

CLEROME GRACILIS,

a Butterfly destructive to Palms.

A social caterpillar with a yellow head, black body, densely covered with long hairs which are rusty red above the base, and freely come out, irritating the human skin, had been found doing damage to Rhopaloblaste palms in the Botanic Gardens. It was reared to maturity and proved to be *Clerome gracilis* Butler.

The caterpillars, both when feeding and when resting, take line from each other: they stand parallel on the lower surface of the leaf that they are or have been eating. They feed at night and rest by day.

When mature, they are nearly two inches long.

The chrysalis is of a brilliant green, angular as that of the familiar tortoise shell butterfly (*Vanessa urticæ* Linn) and hangs by the tail from the under surface of some object.

The butterfly is of a rich brown colour.

I. H. BURKILL.

NOTES ON PLANTS OF INTEREST IN THE BOTANIC GARDENS, SINGAPORE.

Porphyroglottis Maxwelliae, Ridley.

Among the orchids which flowered in the Botanic Gardens, Singapore, in 1913, was *Porphyroglottis Maxwelliae*. This strange orchid of still somewhat doubtful affinities was described by Mr. Ridley in 1896, from dried specimens and drawings sent to him from Sarawak. Otherwise it has remained unknown, and living plants had been in no Botanic Garden, until a small collection from Dutch Borneo was offered to him for purchase in 1911. By chance *Porphyroglottis Maxwelliae* was in the collection.

A new Variety of Eria gracilis, Hook. f.

An orchid which has recently flowered in the Botanic Gardens is *Eria gracilis* in a variety not described. The lip is obcuneate, with the middle lobe reduced to a minute point overtopped by the truncate side-lobes. It may be called var. *obcuneata*.

There is a label on the Singapore plant calling it a "Dendrobium from Java." Possibly this label has been transferred from another plant, for *Eria gracilis* is a local orchid of Singapore, extending northwards to Penang, but unknown in Java.

The flowers are flesh-coloured with sparse crimson hair outside and the lip has a crimson line down its very margin, as in the allied *E. oligantha,* Hook. f.

A new Variety of Sarcochilus stenoglottis, Hook. f.

A variety of *Sarcochilus stenoglottis* flowered in the Gardens early in August. Unfortunately the origin of the plant is unknown.

Sarcochilus stenoglottis was described by Sir Joseph Hooker in the Flora of British India, vi. (1894) p. 34; and a plate is given in the Annals of the Royal Botanic Gardens, Calcutta, v., (1895) t. 62, a reproduction of a sketch made in Calcutta in 1883, from a plant obtained in Sumatra by Kunstler.

The plant which has come under observation has red colour neither in the peduncle nor in the flower; and the margins of the lip are not frilled, but even.

A drawing has been placed in the Singapore collection.

Habenaria Havillandi, Kränzlin.

In 1912, Mr. J. W. Anderson, the Assistant Curator, was sent on a collecting trip to Sarawak, whence he brought back a series of interesting plants. One of the plants proved to be the orchid *Habenaria Havillandi*, Kränzlin. Large green flowers are always interesting, because the number of species having them is small; *H. Havillandi* is one of the number. The flowers, vertically from the tip of the upper sepal to the tip of the labellum, measure 2 cm.; the spur is long and full of honey at the lenticular end; the flowers have a faint but pleasant scent. Many of them are open together, so that in a conservatory with a setting of flowers of other colours this orchid is quite conspicuous. It flowers twice a year.

The explosive Flowers of Plocoglottis porphyrophylla, Ridley.

Another orchid, brought back by Mr. Anderson from Sarawak, proved to be *Plocoglottis porphyrophylla,* a plant of wide distribution in Malaya, but because inconspicuous and a lover of deep shade, little known. The Sarawak plant carried only one flower open at a time, but it remained in flower over more than three months, producing a fresh one every few days until the raceme was more than two feet long, and had borne fifty. Specimens and drawings in the Singapore herbarium indicate that sometimes two flowers may be expanded at the same time; this, however, never happened in the plant which came under observation.

The flowers have a most conspicuous asymmetry, are explosive, and exhibit an extraordinary series of changes, which have passed undescribed hitherto; indeed the existing descriptions of the flower are quite inadequate for giving any true idea of its appearance. Other species of Plocoglottis have bilateral symmetry, and seem widely distinct enough from our subject.

It is convenient to begin the description of the flower by an account of the half-grown bud.

The ovary begins to twist, as is the way in orchids, when by its growth it has overtopped the bract; it carries the swelling bud through about 75 degrees and then stops twisting. During this twisting the dorsal sepal outgrows the other sepals pushing over the apex of the bud. If the bud be dissected the tips of the lateral petals will be found within the apex, but the lip only slightly overpasses the middle of the bud,

All the sepals at this stage are similarly narrowly ovate, the lateral sepals being asymmetrically so. The lateral petals are linear, and curved round the column to meet at their tips. The lip is nearly as broad as long, cuspidate above its broad shoulders, with the margins in the lower part frilled and turned under. If these margins be uncurved it will be seen that they are the lateral lobes of the lip. Under each broad shoulder a wart has begun to form: three lateral nerves end close to each of these warts.

Between this stage of the bud and maturity the following changes take place. The contiguous halves of the lateral sepals thicken from the middle upwards; the cuspidate tip of the lip turns back, its shoulders enlarge and the warts become sharp little upstanding cones, while the side lobes increase along their margins so that they are too full for the space that they have and towards the base of the lip tend to form an upstanding rounded crest.

Two very fleshy bodies, being the staminodes, lie within the curve of this crest, one on each side.

The opening of the flower takes place late in the afternoon or in the early part of the night. In it, as a commencement, a slit appears between the lateral sepals from the middle, downwards first, and then to the tip. Next these lateral sepals break away and slowly take a position at right angles to the ovary, and their thickened areas begin to become convex inwards and throw the thin parts back. Following this movement the lateral petals rapidly elongate, curving over strongly so that their points pass between the bases of the lateral sepals, and in this curious action they deflex the lip on its base holding it down against a certain amount of resistance, in contact with the lateral sepals. Thus the flower gapes somewhat.

If in the early stage of the flowering, the lateral petals are cut, the lip springs up elastically against the column, being forced up by the turgid tissue at its base and perhaps in less measure by the pull of the margin. Meanwhile the dorsal sepal has not moved.

This is the first stage of the flower and lasts into the night. It is accompanied by the development of two eccentricities: one of these is a movement of the column towards the right hand side of the flower (right hand of an observer facing the flower), whereby later it comes into contact with the shoulder of the lip; the other is the unequal curving of the lateral sepals, the upper curving most, whereby they come to form a platform with their swollen areas presented forwards and upwards, and one, the upper, presses on the tip of the labellum. The bilateral symmetry which was present in the bud is now completely lost.

During the night the second stage comes on, beginning with the turning back of the dorsal sepal, and continued by the straightening of the lateral petals. The upper of the lateral sepals no longer held away from its fellow by the lateral petals, now moves down to be in contact with it, and is thus almost median as regards the lip, and as

the lateral petals move away the lip is left caught lightly against its convex swelling, and held folded down as the lateral petals placed it. A touch now frees the lip and causes it to spring up against the column, its right shoulder being under the pollinia. Pressed thus against the column it remains while the flower withers on the following morning. In withering the lateral petals curve inwards until their tips meet; the lateral sepals rise up until they touch the lower side of the lip; the dorsal sepal follows; and the life of the flower is over.

It has no scent as far as the human nose can test it. It has no free honey. Its colours are lemon yellow to yellowish green with deep crimson markings on the lip; and the swollen parts of the lateral sepals are maroon.

How it is fertilised it is not possible as yet to state, but it would seem likely that insects of rather small size, attracted to the flower, are trapped by the up-springing of the lip against the coloumn, and in struggling to free themselves effect pollination. Sections through the swollen parts of the lateral sepals show that this tissue contains large cells with raphides towards the outer surface, and small cells towards the inner.

The mechanism is most curious; the lip is a trigger put into place by the lateral petals, and held there by one of the lateral sepals. This alone makes it of unusual interest; but the interest is heightened by the angle at which the flower stands, by the movement out of the median plane of the column, and by the movement towards it of a lateral sepal.

Hapaline appendiculata, Ridley.

A third interesting plant brought back from Sarawak by the Assistant Curator is *Hapaline appendiculata* with variegated leaves. Mr. Anderson had found it plentiful near Bau. It flowered in cultivation in the end of May.

Hapaline appendiculata differs from the two other known Hapalines in having an appendix to its spadix, which slightly overtops the narrow white spathe. Is is the most southern representative of a rather badly constituted genus. It was once before in cultivation in the Gardens, but either was lost or is bedded out in some unrecorded nook under the trees. The specimen grown earlier had dark green leaves without the conspicuous pale green cloudy markings of the new one. The leaves take a peculiar attitude, the petiole bending so as to place them beyond the rim of the plant pot in which they may be grown.

I. H. BURKILL.

THE EXTREME HARDNESS OF THE SEEDS OF CAESALPINIA DIGYNA.

In 1910, the writer obtained two dozen seeds of *Caesalpinia digyna,* Rottl., from Burma, intending if possible to isolate on them the water-resistent layer which hinders the germination of quite a number of the Leguminosae, such as *Acacia arabica* and various indigos. The intended study was never completed; but observations were made on the resistance of the seeds to germination.

The seeds were placed half-submerged in clean water, which was frequently changed, but none germinated during nine months; next they were allowed to dry and after about three months out of water, they were placed in it again half-submerged as before; still there was no germination. A few were removed from the experiment to see if they were alive; they were cut slightly so that the impervious layer was broken, whereupon they all germinated. The remainder passed another six months half-submerged, but did not germinate; then they passed a year dry. Half-submerged again for the third time, as before they did not germinate during two months.

It seemed probable after this that the alternation of wet and dry seasons such as occurs where the plant chiefly grows, has nothing to do with the germination. However, it was thought that perhaps jungle-fires might bring it about; and ten seeds were accordingly placed under a layer of dry leaves prepared to produce a flame a foot high, which was fired; the seeds, when the fire had passed from them, were collected and replaced again in water, they still did not germinate until they were cut. With this the experiments ended, the supply of seeds being exhausted; but the living plants now in cultivation in the Economic Garden, Singapore, are the offspring of these seeds.

It seems as if *Caesalpinia digyna* only germinates after direct injury to the outermost layer of the seed-coat.

Several years ago Professor W. R. Dunstan, Director of the Imperial Institute, London, showed what splendid leather is produced by tanning with the pods of this plant, but a barrier to its use was found in the high cost of collecting them from the bushes which grow too scattered. Should it ever be possible to bring the pods into the market, it is most likely to be by encouraging the plant to grow thicker by sowing prepared seeds in waste places.

I. H. BURKILL.

A DISEASE OF AGAVES.

There is a disease on *Agave* plants in Singapore, and in the state of Johore, due to a fungus. This fungus attacks the mature leaves on the upper surface, rendering them valueless for the

extraction of fibre. The first sign of it is the appearance of white blotches which spread, then darken to a deep brown, becoming sunken, and when quite dead the skin takes on a rather silvery look; this change is followed by the breaking out of small black pustules which are often in rather regular concentric rings.

On cutting sections of the diseased parts of the Sisal plants it can be seen that in the earlier period of the attack the bleaching is due to the destruction of the chlorophyll-containing cells under the epidermis, whereby cavities are formed leading to the shrinkage of the dying epidermis onto the layer of fibres below. The whole afterwards becoming more and more disorganised, air obtains access to the cavities; and this leads to the silvery appearance. In the final stage spores of a fungus are formed in the cavity under the epidermis and escape through cracks in it.

The attack is like that of the fungus *Colletotrichum Agaves* which is described and figured in the Sixteenth Annual Report of the Missouri Botanic Garden, 1905, p. 153, plates 35-37, but the destruction seems to spread more longitudinally down the leaf, and under the microscope it is seen that the spores are not the spores of a *Colletotrichum,* but of a fungus of the allied genus *Coryneum.*

Coryneum and *Colletotrichum* both belong to the Melanconiales, and as they are of the same habit, the treatment for one would seem to be the treatment for the other.

Colletotrichum Agaves is known to occur in India, and may be attacked as recommended by Dr. Butler, in the Agricultural Journal of India, i. p. 260, thus :—

"SISAL HEMP DISEASE. A disease of cultivated Agaves, caused by the fungus *Colletotrichum Agaves* . . . . . has been found in several parts of India, and has been the cause of alarm on Sisal estates. In America it has not been known to attack Sisal; but in India it often does so. The older leaves are first attacked, sunken patches appearing where the fungus has entered. These turn brown and dry up in the centre, while they spread at the margin In the dried up parts, spores are produced in little black clumps, which blow about and infect healthy leaves . . . . . All diseased leaves should be cut and burnt as soon as the patches appear."

In the Report of the Missouri Botanic Garden, it is recorded that the garden authorities had succeeded in checking the spread of the disease by such means; but it is added that moisture predisposes to the attack. Missouri with its dry climate then has a great advantage over this country where we cannot avoid the moisture.

I. H. BURKILL.

THE FERTILISATION OF CACAO.

The number of Cacao pods formed on a tree is very much out of proportion to the number of flowers produced. In Dominica, West Indies, there is formed but one pod to every two hundred flowers. To ascertain why this is so, Mr. G. A. Jones has had plants under observation in that island, but without reaching a final conclusion. This, however, was ascertained that if the common red ants which tend green fly about the flowers are kept away, no pollination at all results. The criticism which comes to the mind on reading the remarks of this observer, is that the pollination only takes on one flower out of every two hundred; and that positive evidence is required to prove that the red ants have anything to do with the fertility of the flowers.

CAPRIFICATION IN MALAYA.

A paper in the Philippine Journal of Science, viii., section D., No. 2, (1913) p. 63, by Mr. C. F. Baker, on the fertilisation of the Philippine fig—*Ficus nota*, Merrill, is of great interest. As is usual in fig-trees there are produced on certain sterile trees, figs holding gall-flowers associated with male flowers, wherein the fertilising fig-insects breed; and there are produced fertile figs on other trees, to which the fertilising insects bring the pollen from the sterile trees. The multiplication of the insects, of which on *Ficus nota* there are no less than seven species, goes on all through the year; one insect is a *Blastophaga*, similar to that which fertilises the Smyrna fig. "If a large mature caprifig (gall-fig) be opened, the walls of the interior are found to be thickly massed with the densely packed brown galls, produced from the modified ovaries of the infertile flowers" ..... "In due time from certain of the galls appear numbers of queer clumsy wingless yellow insects, the males of the Blastophaga. Immediately after they emerge they turn their attention to gnawing small holes in the still unopened galls; this—their quest for the female—seems completely and continuously to occupy their attention. Many times holes are made, then immediately deserted," if the quest has been fruitless. These small holes are made at any accessible point on the surface of the gall. In case the gall happens to contain a female Blastophaga, the tip of the male's abdomen which is closely recurved under the body and projects forward between the fore legs and just beneath the mouth, is introduced into the gall without any change in general attitude of the body of the male, and copulation with the imprisoned female takes place ..... Copulation accomplished, the males make no attempt whatever to enlarge the minute hole made for this purpose, "but leave the female to gnaw her own way out, which she

does immediately after copulation. This is in striking contrast to the case of the Smyrna fig insect in which, the male is supposed, as stated by Eisen, to liberate the female after copulation. However, observations on this point should be repeated. The male continues on its quest, rapidly gnawing into gall after gall and repeating the act of copulation, until exhausted and dying. In its nervous haste it occasionally bites into the stamens also, but any intentional attack on the stamens, as described by Cunningham for *Ficus Roxburghii*, does not occur in *Ficus nota*. With the rapid emergence of the males, followed by the emergence of the females, the scene in the fig becomes exceedingly animated, and the more so because during this time, males also of various guests and parasites begin to emerge and seek their respective females.

It is a remarkable fact that the tens of thousands of Blastophagas, guests, and parasites, constantly emerging, apparently make direct for other figs on the same trees or go to other trees of *Ficus nota*. In case the female Blastophaga passes to younger figs on the same tree or on another caprifig, she proceeds at once to the ostiolar end of the receptacle and enters there pushing her body back and forth between the closely overlapping scales in most laborious fashion, until the interior is reached." Whether the wings are broken off during this attempt, as states by Eisen for the Smyrna *Blastophaga* or whether they are deliberately removed by the insect tiself, as occurs in the female of many ants, Mr. Baker was unable to ascertain. In any event entrance of the fig always involved dealation. "Having accomplished entry to the fig, the females find the specially modified funnel shaped stigmas awaiting the deposition of eggs, and insert one to each style just within the ovary, so that it lies upon the ovule destined to furnish food to the developing larva. One female is capable of depositing very many eggs; . . . . . and often as many as a dozen females or more gain entrance to the same fig, so that the oviposition is usually quite complete. The female dies immediately after egg-laying is concluded. However, in case the female has found her way to a tree bearing only figs destined to produce seed, and she seems entirely incapable of detecting this fact, she enters the figs in the same way, but there encounters only stigmas . . . . . not adapted to the reception of her eggs. She vainly searches the interior of the fig, over and over, involuntarily distributing to the normal stigmas the pollen with which her body was thoroughly dusted, until thwarted and exhausted, she finally dies. From one to a dozen or more dead bodies of females sacrificed to this service may be found in each young fertile fig."

None of the guests nor parasites of *Ficus nota* enters the fig by the ostiole for oviposition as does the *Blastophaga*. They all possess ovipositors of extraordinary length with which the entire wall of the receptacle is pierced. Thus are they of no use in the bringing of figs to maturity. It is the female *Blastophaga* which alone does the work.

RECORD OF A FEW ORCHIDS

and other interesting plants found in Setol and on Kedah Peak.

During a collecting expedition to Setol and Kedah Peak in 1912, the following orchids and other plants were collected for the Waterfall Gardens, Penang. It is of interest to record their occurrence in the places named.

Melastomaceæ.

Sonerila cyclaminella, Stapf and King. ...	K. Peak.

Gesneraceæ.

Didymocarpus citrina, Ridl. ...	K. Peak.
D. albina, Ridl. ...	K. Peak.

Orchidaceæ.

Dendrobium cruentum, Reichb. f. ...	Setol.
D. secundum, Wall. ...	Setol.
D. tenuicaule, Ridl. ...	Setol.
D. hymenopterum, Hook. f. ...	Kedah Peak.
D. atrorubens, Ridl. ...	K. Peak.
Platyclinis linearis, Ridl. ...	K. Peak.
Bulbophyllum Lobbii, Lindl. ...	K. Peak.
B. stella, Ridl. ...	K. Peak (flower widely expanded).
Eria ochracea, Rolfe. ...	Setol (Kew Bulletin No. 9, 1909, p. 366).
Spathoglottis aurea, Lindl. ...	K. Peak.
Cypripedium niveum, Reichb. f. ...	Setol.
Arundina chinensis, Blume, (A. Philippii, *Reichb. f.*) ...	K. Peak.
Habenaria carnea, N. E. Br. ...	Setol.
Spathoglottis Handingiana, Par. and Reichb. f. ...	Setol.
Saccolabium curvifolium, Lindl. ...	Setol.
Eulophia graminea, Lindl. ...	Setol.
Calanthe rubens, Ridl. ...	Setol.
Coelogyne asperata, Lindl. ...	K. Peak.
C. Dayana, Reichb. f., var. *tomentosa*.	K. Peak.
Phalaenopsis esmeralda, Reichb. f. ...	K. Peak.
Dipodium pictum, Reichb. f. ...	K. Peak.
Anoetochilus Reinwardtii, Blume. ...	K. Peak.
Acanthephippium sp. ...	Setol.
Arisaema fimbriatum, Mast. ...	Setol.

Filices.

Matonia pectinata, R. Br. ...	K. Peak.
Dipteris Lobbiana, Moore. ...	K. Peak.

Lycopodiaceæ.

Lycopodium Hookerii. ...	K. Peak.
Do. phlegmaria, Linn. ...	K. Peak.

MOHAMED HANIFF.

RAINFALL

at the Director's House, Botanic Gardens, Singapore, from February 12th, when a new guage was put into position, to June 30th, 1913.

Readings taken always at 8 a.m., and credited to the date in which the twenty-four hours began.

Day.	February	March.	April.	May.	June.
1st	not recorded	Trace	0.31	0.05	0.02
2nd		1.81	..	3.40	1.14
3rd		6 62	0.38	0.05	0.04
4th		4.25	...	0.05	0.47
5th		0 07	1 49	0.10	0.01
6th		0.62	0 01	0.46	...
7th		...	0.36	Trace	1.55
8th		0.02	0 82	...	0.23
9th		0.55	0.10	...	0.01
10th		0.94	0.34	0 26	...
11th		..	...	0.07	Trace
12th	...	...	...	0.46	...
13th	...	0.03	0.14	0.01	0.15
14th	...	...	...	0.37	Trace
15th	Trace	...	....	2.09	...
16th	...	...	0.12	Trace	1.28
17th	...	0.08	...	...	0.28
18th	...	0.83	0.05	...	1.30
19th	...	...	...	0.07	0.04
20th	...	...	3 15	0.31	1.30
21st	...	...	0.11	Trace	0.38
22nd	...	0.06	...	0.17	Trace
23rd	0.01	0.01	1.51	...	1.30
24th	...	0.84	...	...	0.47
25th	..	...	...	0.37	0.36
26th	0.15	0.07	...	0.05	0.30
27th	0.36	1.50	0.76	...	Trace
28th	0.48	0.35	0 24	...	3.96
29th		...	...	0.58	...
30th		...	0.10	...	1 87
31st		0.05		0.27	

LISTS OF PLANTS,

which may be obtained generally at the Prices stated, from the Botanic Gardens.

The cost of packing and all subsequent charges are extra.

LIST A.—Ornamental Plants.

	$ cts.	
Abrus precatorius—Crab's Eye—climber ...	0 10	
Acalypha Godseffiana—shrub ...	0 15	
Acalypha macrophylla—shrub ...	0 15	
Acalypha macrostachys—shrub ...	0 15	
Acalypha torta—shrub ...	0 15	
Acalypha obovata—shrub ...	0 15	
Acalypha Sanderiana—shrub ...	0 15	
Actinorhytis calapparia—palm ...	0 20	and upwards
Adiantum Capillus-Veneris—Maiden Hair fern	0 50	and upwards according to size and variety or race
Aglaonema commutatum—pot plant ...	0 15	and upwards
Aglaonema costatum—pot plant ...	0 50	„
var. inornatum ...		
var. virens ...		
Allamanda cathartica—shrub ...	0 15	
Allamanda Schottii—half scandent shrub ...	0 15	
Allamanda violacea—half scandent shrub ...	0 40	
Alloplectus Lynchii—pot plant ...	0 20	
Anemia rotundifolia—fern ...	1 00	and upwards
Angelonia salicariaefolia—half herbaceous plant	0 10	
var. alba ...	0 10	
Anthurium Bakeri—pot plant ...	1 00	and upwards
Anthurium cristallinum ...	1 00	„
Antigonum leptopus—Honolulu creeper ...	0 15	„
var. alba ...	0 15	„
Antigonum guatemalensis—climber ...	0 25	„
Archontophoenix Alexandrae—palm ...	0 25	„
Areca Catechu—Betel-palm ...	0 15	
Arenga saccharifera—Kabong—palm ...	0 20	
Aristolochia Duchartrei—climber ...	0 20	
Aristolochia hians—climber ..	0 25	
Aristolochia elegans—climber ...	0 15	
Aristolochia saccata—climber ...	0 50	
Aristolochia gigas var. Sturtevantii—climber	1 00	
Arundina bambusaefolia—terrestial orchid ...	0 25	and upwards
Arundo donax var. variegata—ornamental grass	0 20	
Asparagus plumosus—climber ...	0 50	and upwards
Asparagus Sprengeri—climber ...	0 50	„
Attalea spinosa—palm ...	0 50	„
Barleria prionitis—shrub ...	0 20	

Bauhinia spp.—shrub	0	25	
Beaumontia grandiflora—flowering climber	0	25	
Beloperone oblongata—shrub	0	20	
Bignonia magnifica—climber	0	25	
Bignonia crucigera—climber	0	25	
Bignonia aequinoctialis—climber	0	15	
Bougainvillaea glabra—climbing shrub	0	20	
Bougainvillaea Sanderiana—climbing shrub	0	25	
Bougainvillaea lateritia—climbing shrub	1	00	
Bromheadia palustris—terrestial orchid	0	25	
Brownea ariza—flowering tree	0	50	
Brunfelsia americana—shrub	0	20	
Buxus sempervirens—Box	0	25	
Caesalpinia pulcherrima—shrub	0	25	
Callistemon linearis—shrub	0	25	
Calanthe veratrifolia—terrestial orchid	1	00	and upwards
Calyptrocalyx spicatus—palm	0	25	,,
Camoensia maxima—climber	0	25	
Canna indica, various races, unnamed	0	05	
named races	0	10	and upwards
Cassia fistula—Indian Laburnum—small tree	0	40	
Cassia siamea—flowering tree	0	15	
Casuarina equisetifolia—tree	0	20	and upwards
Chlorocodon Whiteii—climber	0	10	
Chonemorpha Rheedii—climber	1	00	
Chrysalidocarpus lutescens—palm	0	25	and upwards
Clerodendron Minnehassae—flowering shrub	0	40	
Clerodendron speciosum—climber	0	15	
Clerodendron capitatum—shrub	0	15	
Cocos plumosa—palm	0	25	and upwards
Cocos flexuosa—palm	0	25	,,
Congea tomentosa—climber	0	25	
var. azurea	0	20	
Crotons—Codiaeum—in variety	0	10	and upwards
Cryptostegia madagascariensis—flowering shurb	0	25	
Cymbidium Finlaysonianum—orchid	1	00	and upwards
Cyrtophyllum fragrans—Tembusu—tree	0	10	
Daedalacanthus nervosus—shrub	0	20	
Dendrobium thyrsiflorum—orchid	1	00	
Dictyosperma album—palm	0	40	and upwards
Dieffenbachia spp.—pot plants	0	25	,,
Dipladenia Harrisii—climber	1	00	,,
Dracaena fragrans var. Lindeni—foliage plant	0	25	,,
Duranta Ellisii—shrub	0	15	
Duranta Plumieri—shrub	0	15	
Dypsis madagascariensis—palm	0	25	and upwards
Elaeis guineensis—palm	0	15	,,
Eranthemum atropurpureum—shrub	0	15	
Eranthemum malaccense—shrub	0	25	

Eranthemum reticulatum—shrub	...	0 15	
Eranthemum Wattii—shrub	...	0 50	
Eucharis grandiflora—Amazon Lily	...	0 15	
Euphorbia heterophylla—herb	...	0 05	
Evodia hortensis—shrub	...	0 15	
Evodia Ridleyi—shrub	...	0 20	
Excœcaria bicolor—shrub	...	0 15	
Faradaya papuana—climber	...	0 25	
Ficus Benjamina—tree	...	0 20	
Ficus repens—creeper	...	0 25	
Filicium decipiens—small tree	...	0 25	
Gardenia florida—shrub	...	0 20	and upwards
Gloriosa superba—climber	...	0 15	
Gratophyllum hortense—shrub	...	0 15	
Hamelia patens—shrub	...	0 25	
Hemigraphia colorata—creeper	...	0 15	
Heterospathe elata—palm	...	0 25	and upwards
Hibiscus Cameroni—shrub	...	0 15	
Hibiscus mutabilis—shrub	...	0 15	
Hibiscus Rosa-sinensis—Shoe-flower—shrub		0 10	
var Cooperi	...	0 20	
Hibiscus schizopetalus—shrub	...	0 10	
Holmskioldia sanguinea—shrub	...	0 25	
Hosea Lobbii—climber	...	0 20	
Inga (Pithecolobium) saman—Rain tree	...	0 15	
Ipomoea digitata—climber	...	0 15	
Ixora Bandhuca—shrub	...	0 15	
Ixora coccinea—shrub	...	0 15	
var. lutea	...	0 20	
Ixora macrothyrsa—shrub	...	0 20	
Jacobinia magnifica, var. carnea—shrub	...	0 40	
Jacquemontia violacea—climber	...	0 25	
Jacaranda mimosaefolia—tree	...	0 25	
Jasminum Sambac—half climbing shrub	...	0 25	
Kentia Woodfordii—palm	...	0 50	and upwards
Kopsia fruticosa—shrub	...	0 20	
Lagerstroemia Flos-reginae—tree	...	0 25	
Lagerstroemia indica—shrub	...	0 25	
Lagerstroemia subcostata—tree	...	0 40	
Lasia heterophylla—herb	...	0 25	and upwards
Ledenbergia roseo-oenea—herb	...	0 15	
Licuala grandis—palm	...	1 00	and upwards
Licuala spinosa—palm	...	0 25	„
Licuala triphylla—palm	...	0 25	„
Livistona altissima—palm	...	0 25	„
Livistona chinensis—palm	...	0 25	„
Livistona Hoogendorpii—palm	...	0 25	„
Lobelia syphilitica—herb	...	0 25	„
Lonicera macrantha—Honeysuckle	...	0 20	
Malpighia coccigera—shrub	...	0 15	

Malpighia nitida—shrub	...	0	25	
Martinezia caryotaefolia—palm	...	0	25	and upwards
Memecylon coeruleum—shrub	...	0	25	
Mesua ferrea—tree	...	0	50	
Miconia Hookeriana—pot plant	...	0	25	
Montrichardia aculeata—herb	...	0	25	
Murraya caloxylon—shrub	...	0	25	
Mussaenda erythrophylla—half climbing shrub		0	25	and upwards
Mussaenda luteola—shrub	...	0	15	
Nyctanthes Arbor-tristis—shrub	...	0	25	
Oreodoxa regia—palm	...	0	25	and upwards
Orthosiphon stamineus—half herbaceous	...	0	15	
Panax fruticosum—shrub	...	0	15	
var. Guilfoylei	...	0	20	
var. Victoriae	...	0	15	
Pandanus graminifolius—Screw pine	...	0	25	and upwards
Pandanus Houlletii—Screw pine	...	0	25	„
Pandanus utilis—Screw pine	...	0	15	„
Passiflora laurifolia—Sweet Cup or Passion Fruit		0	15	
Passiflora vitifolia—climber	...	0	25	
Passiflora Watsoniana—climber	...	0	25	
Pentaclethra filamentosa—tree	...	0	40	
Pergularia odoratissima—climber	...	0	15	
Petrea volubilis—half scandent shrub	...	0	25	
Phaleria Blumeii—shrub	...	0	25	
Philodendron gloriosum—ornamental plant	..	1	00	and upwards
Phoenix rupicola—palm	...	0	25	„
Phoenix reclinata—palm	...	0	25	„
Phoenix Roebelini—palm	...	2	00	„
Phyllanthus pulcher—shrub	...	0	10	
Pinanga Kuhlii—palm	...	0	25	and upwards
Pinanga patula—palm	...	0	25	„
Pithecolobium Saman—Rain tree	...	0	15	
Plumbago rosea—shrub	...	0	20	
Plumeria lutea—shrub	...	0	20	
Podocarpus neglectus—tree	...	0	25	
Poinciana regia—Gold-mohur tree	...	0	15	
Porana volubilis—climber	...	0	15	
Ptychococcus paradoxus—palm	...	0	50	and upwards
Ptychosperma McArthuri—palm	...	0	20	„
Ptychosperma sanderiana—palm	...	0	50	„
Quassia amara—shrub	...	0	25	
Randia macrantha—shrub	...	0	40	
Raphia Hookeri—palm	...	0	50	and upwards
Rhapis flabelliformis—palm	...	0	25	„
Rhopaloblaste hexandra—palm	...	0	20	„
Roupellia grata—shrub	...	0	50	
Ruellia ciliatiflora—	...	0	10	
Russelia juncea—shrub	...	0	15	
Russelia sarmentosa—shrub	...	0	20	

Saraca declinata—tree	...	0 50	
Saraca indica—tree	...	0 50	
Saraca trijuga—tree	...	0 50	
Saraca taipingensis—tree	...	0 50	
Sagus laevis—Sago palm	...	0 20	and upwards
Salvia coccinea—flowering herb	...	0 15	
Sanchezia nobilis—shrub	...	0 10	
Sarcocephalus esculentus—shrub	...	0 25	
Selaginella spp.—various	...	0 25	and upwards according to size and variety or race
Solandra grandiflora—shrub	..	0 20	
Solanum maroniense—shrub or small tree	...	0 25	
Spathodea campanulata—tree	...	0 15	
Stephanotis floribunda—climber	...	0 75	and upwards
Stevensonia grandifolia—palm	...	0 25	„
Stigmaphyllon ciliatum—climber	...	0 15	
Stigmaphyllon lancifolium—climber	...	0 20	
Strobilanthes Dyerianus—foliage plant	...	0 25	
Tabernaemontana coronaria—shrub	...	0 20	
Tecoma stans—shrub	...	0 20	
Thunbergia erecta—shrub	...	0 20	
Thunbergia laurifolia—climber	...	0 15	
Tinnea aethiopica—shrub	...	0 15	
Tinnea Sacleuxi—shrub	...	0 15	
Tococa platyphylla—shrub	...	0 25	and upwards
Tristellateia australasica—creeper	...	0 15	
Turnera ulmifolia—herb	...	0 15	
Verschaffeltia splendida—palm	...	0 25	and upwards
Vinca rosea—herb	...	0 10	
var. alba.	...	0 10	
Vitis discolor—climber	...	0 15	
Wedelia biflora, double flowered—shrub	...	0 15	
Xanthosoma Lindeni—pot plant	...	1 00	and upwards
Zalacca edulis—palm	..	0 15	and upwards

LIST B.—Economic Plants.

AT TWO CENTS PER SEEDLING OR PER SUCKER.

Alpinia Galanga—Galangal
Curcuma longa—Turmeric
Cymbopogon Nardus—Lemon Oil Grass
Hevea brasiliensis—Para Rubber tree
Mentha viridis—Mint
Panicum maximum—Guinea Grass
Sanseviera zeylanica—Bowstring hemp
Sanseviera sulcata
Sanseviera guineensis

AT THREE CENTS PER SUCKER OR PER ROOT.

Ananas sativa—Pineapple, races Mauritius, Ruby Jamaica, Harvey's and Pernambuco

Andropogon squarrosus
Boehmeria nivea—Rhea or Ramie, two races
Boehmeria tenacissima
Maranta arundinacea—Arrowroot

SOLD AT 15 CENTS IN FOUR-TO SIX-INCH POTS, OR AT MORE THAN 15 CENTS IF LARGE PLANTS IN LARGER POTS.

Adenanthera pavonina
Achras Sapota—Chiku
Aegle Marmelos—Bel
Albizzia moluccana
Aleurites triloba—Candle nut
Aloe vera—Barbados aloes
Anacardium occidentale—Cashew nut
Anona muricata—Soursop
Anona squamosa—Custard Apple
Areca Catechu—Betel nut
Artocarpus integrifolia—Jack fruit
Artocarpus lanceaefolia—Kledang
Artocarpus polyphemia—Champedak
Artocarpus rigida—Monkey Jack
Averrhoa Carambola—Carambola
Boehmeria tenacissima—Ramie
Bouea macrophylla—Kundangan
Cananga odorata
Carapa guineensis
Carica Papaya—Papaw
Castilloa elastica—Central American rubber
Cedrela Toona—Tum
Chrysobalanus Icaco—Coco plum
Chrysophyllum Cainito—Star apple
Cinanmomum iners
Citrus decumana—Pumelo, white fleshed
Citrus decumana—Pumelo, red fleshed
Citrus medica, var. acida—Citron
Citrus acida—Lime
Citrus Aurantium—Orange, Chinese
Coffea arabica—Arabian coffee
Coffea Laurentii
Coffea liberica—Liberian coffee
Coffea stenophylla
Coffea zanzibarica
Cola acuminata—Cola
Connarus semidecandrus
Cordia myxa
Croton tiglium—Croton oil plant
Cynometra cauliflora—Num-num
Derris elliptica—Tuba

Dialium laurinum—Kranji
Dichopsis gutta—Gutta percha tree
Diospyros discolor—Mabola
Durio zibethinus—Durian
Elaeis guineensis—African oil palm
Erythina indica—Dadap
Eugenia brasiliensis—Brazil cherry or Grumixameira
Eugenia grandis—Jambu ayer laut
Eugenia jambos—Rose apple
Eugenia leptantha
Eugenia malaccensis—Malay apple
Eugenia uniflora—Ibipitanga
Eugenia xanthocarpa
Erioglossum edule—Mertajam
Flacourtia Cataphrata
Flacourtia Ramontchi
Funtumia elastica—Lagos rubber tree
Garcinia Cowa
Garcinia dulcis—Mundu
Garcinia ferrea
Garcinia Mangostana—Mangosteen
Inocarpus edulis—Othaheite Chestnut
Jagera speciosa
Jatropha Curcas
Lansium domesticum—Langsat
Lansium domesticum, var. Duku—duku
Manihot Glaziovii—Ceara rubber
Mimusops Elengi—Bunga tanjong
Mitrephora Thorelii
Morus alba—Mulburry
Nephelium lappaceum—Rambutan
Nephelium malaiense—Mata kuching
Nephelium mutabile—Pulasan
Noronhia emarginata
Pandanus utilis
Passiflora laurifolia—Sweet cup
Paranephelium macrophyllum
Pentaclethra filamentosa
Piper nigrum—Pepper
Pithecolobium acre
Pithecolobuim Saman—Rain tree
Pittosporum pentandrum
Pittosporum viridiflorum
Pithecolobium fasiculatum
Pogostemon Patchouli—Patchouli
Psidium Guajava—Guava, large fruited
Psidium laurifolium
Pterocarpus indicus
Sandoricum radiatum—Kechapi
Spondias dulcis— a Mauritius race

Sterculia Jackiana
Strophanthus dichotomus
Styrax Benzoin
Swietenia macrophylla—Broad leaved Mahogany
Tamarindus indica—Tamarind
Terminalia Catappa—Bengal Almond
Terminalia procera
Treculia africana
Thespesia populnea
Theobroma Cacao—Cocoa, Garden seedlings
Triphasis Aurantiola
Zalacca edulis—Buah Salak

AT 25 CENTS IN LARGE POTS.

Cinnamomum Camphora—Camphor tree

AT 50 CENTS EACH IN LARGE POTS.

Achras Sapota—Chiku, grafted plants
Eugenia caryophyllata—Clove
Myristica fragrans—Nutmeg

FORTHCOMING CONGRESSES.

The fourth International Congress of Tropical Agriculture and Colonial Development will meet in London in 1914. Those wishing to join the congress may enroll themselves as members of the International Association of Tropical Agriculture and Colonial Development, paying one pound per annum, (due on the first of January of each year), to the Secretary, British Section of the International Association, Imperial Institute, London, S.W., and for this they will receive all the publications of the Association and the quarterly Bulletin of the Imperial Institute, in addition to being entitled to take part in the London Congress.

An International Rubber Congress is to be held in Batavia from September 7th to 10th, 1914, in connection with the Batavia Rubber Exhibition (September 8th to October 10th).

The International Botanical Congress, held at Brussels, in May, 1910, decided on the invitation of the Royal Society of London, that the next Meeting should be held in London, and it has now been arranged, that it, the fourth Congress, will take place from May 22nd to May 29th, 1915. The subscription for membership of the Congress is fifteen shillings. Members will receive all the publications. Ladies accompanying members may attend the meetings and excursions of the Congress on payment of ten shillings each. The General Secretary of the Organizing Committee for the coming Congress is Dr. A. B. Rendle, British Museum of Natural History, South Kensington, London, S.W.

The

Gardens' Bulletin

STRAITS SETTLEMENTS,

into which is incorporated all that has been published as the third series of the Agricultural Bulletin of the Straits and Federated Malay States.

Vol. I. Issued June 20th, 1914. No. 7.

CONTENTS.

	PAGE.
The Sirangoon Outbreak (1913) of Brachartona catoxantha	207
Calogramma festiva, Donovan,—a Caterpillar destructive to Crinum asiaticum	209
The big rubber tree, Singapore	210
Seventeen years of tapping in the Waterfall Gardens, Penang	211
Selection of rubber seed	212
The Positions in 1913 of the Agricultural Industries in the Straits Settlements	213
Croton sparsiflorus, Morong,—an American invader	235
Kenari seeds	237
Rainfall at the Botanic Gardens, Singapore, during the second half of 1913	240
Rainfall at the Waterfall Gardens, Penang, through 1913	241
Summary of Rainfall, 1913	243
A Spadix in the Axil of the Spathe of Xanthosoma	244
Grammatophyllum flowering in January	244
Some pertinent publications	244

To be purchased at the Botanic Gardens, Singapore from Messrs. Kelly and Walsh, Ltd., No. 32 Raffles Place and 194 Orchard Road; and the Straits Times Office, Cecil Street, Singapore.

DEPARTMENTAL NOTICE.

A few plants of the Avocado or Alligator Pear—*Persea gratissima,* and a few plants of the Brazil nut—*Bertholletia excelsa*—to be sold within the Peninsula at fifty cents each.

Seeds of *Hevea brasiliensis*—Para Rubber—as available from little tapped trees, twenty-eight years old, to be sold at fifty cents per hundred.

THE

GARDENS' BULLETIN,

STRAITS SETTLEMENTS.

INTO WHICH IS INCORPORATED ALL THAT HAS BEEN PUBLISHED AS THE THIRD SERIES OF THE AGRICULTURAL BULLETIN OF THE STRAITS AND FEDERATED MALAY STATES.

The Gardens' Bulletin is published as material becomes available. Its price is fifty cents a copy, post free, or in advance for a volume of twelve numbers, post free,

Five dollars in the Straits and Federated Malay States,

Nine and a half rupees in India and Ceylon,

Thirteen shillings in Europe.

Subscriptions paid to the third series of the Agricultural Bulletin, Straits and F. M. S. are counted as subscriptions to it.

SINGAPORE:
THE STRAITS TIMES PRESS, LIMITED.

THE

GARDENS' BULLETIN,

STRAITS SETTLEMENTS.

Vol. I. Issued June 20, 1914. No. 7.

THE SIRANGOON OUTBREAK (1913) OF BRACHARTONA CATOXANTHA.

About the middle of the year, 1913, a few moths of *Brachartona catoxantha*—the coconut pest—(vide Agricultural Bulletin, Straits and F.M.S., viii, 1909, page 357, and Bulletin, Department of Agriculture, F.M.S, No. 4) were observed near Singapore town; but no outbreak followed their appearance at that place; instead a severe outbreak followed in the coconut plantations about the head of the Sirangoon river. The centre in the early part of the outbreak was near the Mission church at Sirangoon, and in the small Chinese holdings between it and the Trafalgar Estate; the Trafalgar Estate was rather badly attacked, and also coconut palms about duck farms between the Ponggul Road and the river; while towards Singapore town the caterpillars were to be found sporadically for three miles. They occurred in addition on the leaves of a species of *Calamus* and on those of the *Areca* palm among the coconut palms in the badly affected area.

A generation of moths was found to be emerging from the pupae on November 1st; and several hundred pupae were collected in order to ascertain the degree of parasitisation, as well as the nature of the parasites. The degree was found to be only 4 per cent. and the parasites were in the first place a Tachinid fly, and in the second a Brachonid ichneumon.

As it was evident that these were far from getting the attack under, preparations were made for trying to confine the moth to the area it occupied and for seeking the co-operation of coconut palm owners in the extermination of the pupae. A circular was printed in

Malay, Tamil, and Chinese explaining the nature of the attack, and asking those with attacked trees to burn the lower leaves on which the caterpillars in large quantities had pupated, i.e., the already destroyed leaves. This circular was distributed as soon as an inspector had been appointed for the purpose.

During the month of December, it became evident that the centre of the attack was moving south under the prevailing wind and had got to the junction of the Tampinis Road with the Sirangoon Road. Very sparingly the moth had reached Tanjong Ponggul northwards against the wind.

Spraying meanwhile had been resorted to on the Trafalgar Estate and had done good, for the young trees were free; but the machine was not powerful enough for the spraying of tall palms.

At this stage Nature came to the rescue in the form of a fungus allied to that which causes Muscardine in silk worms—a fungus, new to science which will be described by Mr. G. E. Massee of the Royal Botanic Gardens, Kew, as *Botrytis necans*.

It was first detected near the edge of the Bukit Sembawang Rubber Estate, on the Tampinis Road; and no sooner was it found than it was seized on as a weapon against the moth. The special inspector, having been made familiar with the insect in all its stages and with the fungus, was set to the work of distributing the latter to any colony of caterpillars that he could find free from it. This distribution was done by taking strips of coconut leaves with dead caterpillars or pupae on them, and tying them to the leaves of trees where healthy caterpillars were feeding. Fortunately the caterpillar pupates blatantly in a silken hammock under the leaf that it has been eating, and, if fungus-infected, generally dies inside the hammock, the spores coming to the outside in the form of flour; the fungus is therefore easily found and there was no difficulty in collecting supplies as required.

The inspector, thus working, for instance, spread the fungus through the coconunts about Ponggul, on January 15th, among a brood then maturing which soon pupated and whereof, the Tachinids and Brachonids had but infected 5 per cent. In the next brood the attack was killed out. About Gelong which the moth succeeded in invading, the fungus was also spread; but there is reason to believe that south of the centre the wind did more by distributing the fungus spores that the inspector could have done In February, the outbreak was over.

It is memorable for revealing a means of which we were not aware of possible utility for meeting another attack.

I. H. BURKILL.

CALOGRAMMA FESTIVA, Donovan,—

a Caterpillar destructive to Crinum asiaticum.

In Singapore, the caterpillars of *Calogramma festiva* (a moth), destroy the foliage of *Crinum asiaticum* completely. They live socially, devouring all the green parts of the plant, filling the angles between the leaves and elsewhere with their dejecta, where a mass of putridity arises, among which they may pupate. The putridity is due to the wet dejecta harbouring, in the climate of Singapore, fungi which attack and rot the leaf tissues below, in such a way as to cut off the upper part of the leaf from the bulb; and then the whole blade dies.

The eggs are laid in patches on the plant, covered with a buff felt from the mother moth's body. They are prettily ribbed to the apex. The caterpillars on hatching have a transparent skin with small black bristles arising from swollen bases; and after eating green tissue they look green. They feed by eating the surface of the plant, but seem at a great disadvantage if placed on an old leaf. When three days old, a transverse saddle mark appears behind the head and another on the back before the prolegs, while three faint longitudinal milky white lines become apparent. A day later, dark plum-coloured pigment appears elsewhere in the skin, and also fine milky white lines become apparent between the other lines; when five days old they are already half an inch long, and yellow pigment begins to appear in the dorsal line.

The caterpillars grow to a length of 1½ inches. They appear when full grown to have no hair at all, but in reality have the same kind of scattered small bristles which are present on emergence from the egg. They may be described then as follows:—The skin is black with a narrow median orange brown line down the back, and a nearly even white line down each side half way between the middle of the back and the spiracles. Irregular fine white lines ramify rather sparingly on either side of the straight white line, and every white line is interrupted (but not the orange line) in the segment between the legs and the prolegs, and less definitely on the last segment. Underneath the caterpillars are of a rich brown, and the head is of the same colour.

At maturity the caterpillar has a way when disturbed of raising the fore part of its body and of moving it by jerks.

The life cycle has been observed to occupy seventy five days, so that four broods occur easily within one year.

The moth, which was identified by Dr. R. Hanitsch, is figured in Moore's Lepidoptera of Ceylon, iii, plate 146, fig. 6, and described on page 21 of the text.

I. H. BURKILL.

THE BIG RUBBER TREE, SINGAPORE.

With the first number of the second volume of the "Agricultural Bulletin of the Straits and the Federated Malay States," 1903, a plate was published showing on the right, most of the oldest rubber trees of the Botanic Gardens, Singapore. Those which can be seen, counting from the extreme right, are numbers 1, 2, 3, 4, 5, 7, and 9 of the Gardens' trees: No. 6 and 8 stand a little back, and are not recognisable in the plate. The dimensions of the boles of these trees in the end of 1902, are given on page 1.

Death has spread down the line from No. 5, which was blown over and died in 1905. Between 1905 and 1909 No. 4 died. In 1910 No. 3 died. And now the largest of all, No. 2 is dead. *Fomes semitostus* seems to have been the cause of the trouble; but none of its fructifications have appeared.

The trees were received as seedlings in Singapore in the year 1877, and were planted out in their present place soon after their arrival. They began to seed in 1881. It seems (Bulletin, ix, 1910, page 213) that some of the trees were tapped as early as 1889. It is recorded (Bulletin, ii, 1903, page 112) that between 1893 and 1902, they were very heavily tapped on various occasions; but it is probable that we should not now call the tapping which they had heavy. Tree No. 2, was tapped again as follows:—

18 times between March 26th and May 2nd, and, May 20th and June 6th, 1903.

17 times between January 23rd and February 28th, 1905, by herring bones as a member of a group of trees called "Experiment VII."

73 times between January 22nd and June 1st, 1906, by spirals, yielding 14 lbs. 7½ ozs. of dry rubber and 1 lb. 8 ozs. of scrap.

24 times between November 2nd and November 28th, 1906, by spirals; but the weight of the rubber is not recorded.

26 times between January 7th and February 6th, 1909, by spirals, yielding more or less 8 lbs. 7 ozs. of dry rubber.

54 times between September 6th and October 4th, and, between November 11th and December 6th, 1909, by spirals, yielding 14 lbs. 3½ ozs. of dry rubber.

37 times between January 2nd and February 12th, 1913, by spirals, yielding 11 lbs. of dry rubber.

29 times between December 18th, 1913 and January 30th, 1914, by spirals, yielding 7 lbs. of dry rubber in sheets, 1 lb. of clot and 2 lbs. of scrap.

The tree, however, has never been tested as a rubber yielder, being wanted for seed-producing, and always since 1903 tapped lightly.

Its latex seemed to clot more readily in later years than in the earlier.

It is extremely probable that it was tapped between 1906 and 1909, but records have not been found.

A plate in the Agricultural Bulletin, Vol. vii. 1908, issued with the July number, shows the first spiral tapping of the tree and the old herring bone scars. Another illustration of it from a photograph taken a little later by Mr. H. Overbeck, occurs in Mr. E. Mathieu's "Para Rubber Cultivation," 1909, page 125.

Successive measurements of the bole of the tree at three feet from the ground have been recorded as follows:—

1904, 6th May	... ...	9 feet	1½ inches.
1905, 8th May	... ...	9 „	3¾ „
1906, 8th May	... ...	9 „	5¾ „
1909, 5th May	...	10 „	½ inch.
1910, presumedly in May	...	10 „	1½ inches.
1911, 4th July	... ...	10 „	3 „
1913, 7th May	... ...	10 „	5¼ „
1914, 8th May at removal after death	...	10 „	5 „

These figures indicate that its increase of growth during the last five years has been at the rate of one inch in circumference per annum, and that for the five preceeding years it was at the rate of about two inches per annum.

When uprooted it was found to be 105 feet in height, which is not unusual; but as regards its girth we must count it an abnormality.

I. H. B.

SEVENTEEN YEARS OF TAPPING IN THE WATERFALL GARDENS, PENANG.

In the Waterfall Gardens, Penang, there is a Para Rubber tree, now 28 years old which has been tapped yearly since 1896, a record being kept of its individual yield. A history of it is given on page 385 of volume I, 1901-02, of the Agricultural Bulletin of the Straits and Federated Malay States, together with a plate. As the

experiment is now being discontinued, to record the results is desirable. The weight of dry rubber each year has been as follows :—

		lbs.	*oz.*
1896	... ...	Not recorded.	
1897	... ...	1	0
1898	... ...	3	0
1899	... ...	5	12
1900	... ...	3	12
1901	... ...	2	2⅜
1902	... ...	2	13¼
1903	... ...	3	6
1904	... ...	3	14
1905	... ...	4	12¼
1906	... ...	4	4½
1907	... ...	2	0
1908	... ...	3	8
1909	... ...	8	4
1910	... ...	10	0
1911	... ...	13	0
1912	... ...	13	8
1913	... ...	13	0
	Total ...	98	0⅜

MOHAMED HANIFF.

SELECTION OF RUBBER SEED.

The following is from the Bulletin de l'Association des Planteurs de Caoutchouc, v, 1913, page 305.

" Mr. W. T. Ruys, manager of the Plantation of the Company Rotterdam Tapanoelie, has made a very interesting experiment in selecting seeds of *Hevea*, the result of which the Company has been so good as to communicate to us. Mr. Ruys took 96 seeds in order to ascertain the influence of size on their germinative power and growth, and divided them into four groups, each of 24 seeds, by their size, which were weighed collectively. The seeds were sown on January 22nd, and the seedlings measured on the 11th of June, following, with these results :—

No. of Seeds.	Weight of same in grammes.	No. which germinated.	Stems produced collectively measured in cm.	Average length in cm.	No. of plants of different heights.								
					90 cm.	80 cm.	70 cm.	60 cm.	50 cm.	40 cm.	30 cm.	20 cm.	Less than 20 cm.
24	141.5	20	1271	65.5	1	1	5	4	5	4	–	–	–
24	116.5	18	997	55.5	–	–	4	4	4	4	1	1	–
24	86.5	13	545	42.0	–	–	1	2	1	2	5	1	1
24	42.5	4	96	24.0	–	–	–	–	–	1	–	2	1

The conclusion is that large seeds furnish by far the best results, both as regards germination and as regards growth of the seedlings. One should therefore, before planting seeds, go over them and selecting from them, count as inferior and throw out all which weigh less than five grammes."

THE POSITIONS OF THE AGRICULTURAL INDUSTRIES IN THE STRAITS SETTLEMENTS IN 1913.

In arranging the following statements, the first place is given to the territory of Malacca, because in it Para Rubber—the premier crop of the Malay Peninsula—is more developed than elsewhere.

Territory of Malacca.

If we compare the rubber produced and exported from Malacca with that produced and exported from the whole peninsula, we get the following figures :—

Date.	*Export of the Peninsula.*	*Crop of Malacca.*	*Percentage of the whole which the crop of Malacca makes.*
1911	23,615,417 lbs.	2,180,788 lbs.	9.23
1912	43,102,314 „	5,527,040 „	12.82
1913	77,836,945 „	9,342,997 „	12.00

Having interest to this considerable extent, the Malacca planters during 1913 made themselves leaders in dealing with the important question of wages, and with marked success. Such interest and such success fully justify in themselves the arrangement of material adopted here.

It was in 1898 that Mr. Tan Chay Yan planted 40 acres with Para rubber, mixed with *Ficus elastica*, on Bukit Lintang, near Malacca town, and then formed a Chinese syndicate to plant up more Para rubber (mixed with tapioca) on Bukit Asahan towards the north east corner of Malacca territory, becoming the first outside Negri Sembilan and the second in the whole peninsula to take up an industry which the Government had been putting forward as a possibility for some years. The Government of the Straits Settlements had at that time trees at Singapore, Penang, and near Malacca; the Government of Perak had trees at Kuala Kangsar and near Teluk Anson; and Mr. T. Hislop Hills—the first planter—had trees on his estate at Sungei Ujong. Other trees had been distributed and planted in District Officers' gardens but their history has yet to be collected.

From 1897 the extension of the planting in Malacca was as follows:—

1897 about 3 acres, all Government trees.
1898 23 „ , twenty (or half of forty) belonging to Mr. Tan Chay Yan.
1899 233 „ , thirty-two belonging to Government.
1900 788 „
1901 ?
1902 ? } area returned together with that of gambier,
1903 ? } etc.
1904 5,515 acres, including some *Ficus elastica.*
1905 12,866 „
1906 34,199 „
1907 47,870 „
1908 61,781 „
1909 ? „
1910 72,530 „
1911 80,424 „
1912 95,440 „
1913 117,200 „

Of these 117,200 acres, 65,818 are in the hands of 40 considerable companies, and the rest, amounting to 51,382 is in private hands, being very largely in quite small blocks.

In computing these figures of acreage, catch crops have been taken into consideration; thus, an area planted with tapioca under rubber or an area planted with gambier under rubber, is credited between the two crops in the making up of the total, but as the catch crop is cut out, the whole is credited to the permanent crop, i.e., rubber. Therefore an increase of area may be due to two causes, either to actual planting of rubber trees or to the removal of a catch crop under them, and the great extension of the area under rubber in 1913 is due mainly to this removal of catch crops and not to new plantings, which account for but a tithe. On the figures, 6.7 per cent. of the whole present area is the increase of 1911, and 12.8 per cent. the increase of 1912, but 18.6 per cent. is the increase of 1913. Malacca's stake in the industry is represented by the figures; but what the stake really is, may perhaps be better put in the following table.

Area of the Territory of Malacca—461,120 acres.—

Year.	*Percentage uncultivated.*	*Percentage in rubber.*	*Percentage in other crops.*
1904	67.47	1.20	31.33
1905	66.86	2.79	30.35
1906	65.47	7.42	27.11
1907	64.27	10.38	24.35
1908	64.00	13.39	22.61
1909	62.50	14.00 ?	25.50
1910	54.12	15.73	30.15
1911	47.81	17.44	34.75
1912	47.81	20.70	31.49
1913	43.32	25.42	29.26

They are satisfactory figures in that they leave the conclusion patent that rubber has led to an extension of cultivation instead of making room for itself at the cost of other crops.

It is of considerable importance that the extent of the private holdings in rubber in Malacca, should be borne in mind, because of the part that they might play in any outbreak of a serious disease. There were in Ceylon among the coffee estates similar small holdings with coffee on them, when the coffee-leaf disease broke out, and that they played an important part in causing planters to give up coffee is known; they harboured the disease that the planter was fighting and were an ever-present source of re-infection along his borders. So might these small holdings in rubber serve for mischief, if an epidemic of like nature were to break out in Malacca. Some kind of watchfulness over their state is desirable; and the intelligence necessary for it exists upon the company's estates, but it is uncertain how far, those who might arrange for keeping an eye on the little holdings are alive to the need; reference seems rarely if ever to be made to it from the chair at Company meetings.

So many of the Rubber-planting companies began by the acquisition of holdings, often small, planted with rubber, that a stimulus was given to planting with a view to sale: doubtless a not inconsiderable part of the ground so planted has come under the control of men with a permanent interest in the crop; but there is a little land which will not fall into some planting scheme and bears trees which the owner is not interested in tapping, such as would be more useful and less dangerous to the state if the trees were replaced by something else. The alternative of tapping or eradicating after a certain number of years, perhaps in some cases, might profitably be imposed.

It is certain that the protection belts devised several years ago have not been retained.

The planting companies in Malacca now possess about 105,000 acres, of which 37 per cent. is not yet planted. Some of the companies admit that they have too much land; thus, two are considering the getting rid of a not inconsiderable amount, and the Nyalas Company during 1913 surrendered 5,700 acres; two other companies on the plea that the blocks were detached, and inconvenient therefore, have surrendered 645 acres, and another company has surrendered 263 acres of genuinely sterile hill side. On the other hand four dollar companies which are paying dividends have judged it to their interest to acquire more land to the extent of about 815 acres; and as even with these additions these four companies make but small charges their further expansion would seem likely to be profitable.

The land surrendered or which it is desired to sell, happens to be considerably more than the land acquired by other companies; but it is in no case in rubber, whereas some of the land acquired is.

Taking the available figures of area held at the end of the year, giving attention to the Financial strength of the companies, and assuming an intention to plant if conditions permit, the following approximation has been worked out:—

Land in the hands of the 40 Companies.

Already in rubber	...	63 per cent.
Likely to be planted	...	31 „ „
Perhaps may be neglected	...	6 „ „
		100

If the companies achieve this,—their further planting of 31 per cent. of their holdings—and private planting ceases 32.3 per cent. of the land in the Territory of Malacca will come under rubber; and if private planting should proceed pari pasu (which is unlikely) 39.6 per cent.

The present general abstention from further rubber-planting, which is evident in Malacca as elsewhere, is a taking stock of all that appertains to the position. But it is clear that for the present the production of Plantation Rubber most undoubtedly gives a very good return for money invested in it. The Malacca plantations are well developed; the yield in Malacca seems to be quite satisfactory, and the Malacca estates are generally free from insect pests and fungus diseases. The cases in which they have not attained their estimate are uncommon.

As the Mycologist of thc department of Agriculture, F.M.S., has recently said "Plantation rubber is one of the healthiest crops in existence"; it has to be kept so.

The yield per acre is at present something which, between the expert and the manager, can be calculated with considerable accuracy; but we do not know how the drawing off of so much latex is affecting the yield of the future. A tabulation of the forecasts of yield of twenty-seven Malacca companies, and the actuals realised during the estate-years ending in 1913 (estimated 6,974,250, realised 7,085,846), shews a discrepancy of but 1.6 per cent., thought some of the individual estates had a rather wide margin of difference, notably those whose tapping area was rapidly extending. Five of the estates had worked to within 1 per cent. of their estimate, and ten to within 5 per cent. These ten estates made 4,150,681 lbs. of rubber, or nearly half of the output of Malacca.

The yield on the best estates, as far as recorded, is about two pounds of dry rubber per tree per annum or about 300 lbs. per acre. But this average is worked out on trees which have many years to grow. We do not know yet their maximum yield any more than we know precisely the distance at which trees should be planted to attain this maximum, and the very best way of tapping.

We are suffering of course from disability, due to the circumstance that our crop has not yet been through even one generation under cultivation.

What the figures of yield show is this,—that, carrying out a certain programme of tapping on trees of a certain age planted at a certain number to the acre in the locality to which reference is made, it is possible to manufacture so much rubber and generally this is intended to be without apparent injury to the future. In the Company reports for 1913, or for 1912-13, readily available, the highest figure returned is at the rate of 337 lbs. per acre over 2,982 acres, including some of the oldest rubber in Malacca.

The steadying of prices is a great boon to the industry, though it indicates the approximation of production and demand. Although the long steady drop in prices through 1913 (on the London market from 4s. 8d. in January to 2s. 5½d. in December—highest prices for first quality), undoubtedly went below the natural limit which undisturbed supply and demand would have fixed, on account of strikes, floods and financial uncertainty in America (which country uses 60 per cent. of the world's output) and on account of political anxiety in Europe, where in addition all the markets received an extra quantity of the raw product in consequence of stagnation in America, the fall was certainly due to the increasing output; and the drop after the present recovery may be expected to be resumed. Recognising this all estates seem to have been making most serious efforts to ascertain every possible economy.

The one economy of which most has been heard is that of the reduction of wages. It cannot be denied that wages were excessive, especially when in 1910 "a boy of 12 could get 40 to 50 cts. per diem as a tapper and his work was over at 10-30 or 11 a.m." Meeting on August 10th, 1913, the Malacca planters decided to reduce wages from the 1st of October to 60 cents per diem for a Chinese coolie or 40 cents for a Tamil, Malay or Javanese coolie; the task for a tapper to be 400 trees, or for weeding an eight-hours day. With very little friction this change was brought about; and the labour force in the country was demonstrated obviously sufficient for the country's needs. It was estimated that the reduction in wages would save twopence on each pound of rubber.

Local selling, both in Singapore and Penang, is increasing, as it results in a considerable saving in certain cases, especially when direct shipment to the country of consumption follows. Freight to, and wharf charges in, London have been reduced also.

On the estates there is the natural economy due to the maturing of the trees under which they yield more to the same amount of labour, and further there are economies in cultivation thus: in Malacca there are clean-weeded estates and estates on which a thin

growth of certain grasses is encouraged; under either system the estates seem to have attained generally the object aimed at, and the maintenance in that state is less costly than the attainment. Disc-harrows are in more extended use having, since 1911, proved themselves useful; and steam ploughs are in use on the Devon Estate.

There is probably no estate in Malacca which has not brought down its expenses considerably; and the company reports mention reductions in cost of varying amounts.

The average London prices for first quality Plantation and the amount imported, are given by Messrs. Lewis and Peat thus:—

Year.	*Average price.*	*Amount.*
1911	5s. 6d.	9,500 tons = 21,280,000 lbs.
1912	4s. 10½d.	18,000 „ = 40,320,000 „
1913	3s. 1d.	22,400 „ = 50,176,000 „

Fine hard Para did not fall proportionately, but from 4s. 7½d. to 3s. 2½d., because it is better than Plantation for certain purposes, is controlled by few strong hands able to hold up supplies, and has not the promise of such enormous expansion as has Plantation. That it should have been sold per lb. below Plantation once when the price was high, is because its 18 per cent. of dirt at a high figure becomes so very expensive; but allowing for its impurities, rubber for rubber it has never been cheaper than Plantation. Malaya must make its best product as good as Fine Hard Para for all purposes.

It is admitted on the London market that the quality of the produce of Malaya has improved. Some of this improvement may be ascribed to the increasing age of the trees, but most of it is to the credit of the planter. Earnest endeavours must be made to make Plantation to sell equally with Para; but for the present Plantation more by its volume than its value, competes with Para.

Although low class rubbers have been less abundant on the market lately than formerly, the part which raw plantation has played in driving these out is quite uncertain, for much of their decrease may be due to reclaimed rubber as the industry in reclaiming is assuming enormous dimensions, curiously without any satisfactory figures in regard to it being available, and the product takes a place in direct competition with low class rubbers: and it is to be borne in mind by those interested in producing Plantation, that such improvements may be invented in reclaiming processes as to bring reclaimed rubber to a grade, where its volume will affect the price of the raw product.

The second crop of Malacca formerly was tapioca; it has been the mother crop of very much of the rubber from the time when Mr. Tan Chay Yan and his syndicate planted the Bukit Asahan Estate;

but, with the cutting out of catch crops, the area under it has fallen to the fourth place. Both the acreage and export figures show this fall.

Year.	*Acres.*	*Average price of flake tapioca as declared on export from Malacca.*
1902	67,546	$5.59 per pikul (133.3 lbs.)
1903	71,958	5.03 „
1904	68,762	4.80 „
1905	65,968	6.34 „
1306	67,399	8.91 „
1907	16,753	9.22 „
1908	39,072	6.13 „
1909	—	5.92 „
1910*	18,135	6.35 „
1911	10,926	8.83 „
1912	16,643	8.89 „
1913	7,353	5.98 „

Excess of exports over imports of Malacca in pikuls (133·3 lbs.)

Year.	*Flake.*	*Pearl.*	*Flour.*	*Total excess.*
1909	66,727	64,567	6,830	138,124
1910	85,793	52,398	(import of 4,717)	137,474
1911	38,820	31,889	1,555	72,264
1912	28,157	31,873	1,690	61,420
1913	27,992	28,329	(import of 88)	56,233

The decrease of the crop has come at a time when prices have fallen very considerably; and it is a matter for congratulation that the Malacca estates in recent years have not only reaped the advantage of a return from the catch crop, but they reaped it when the return was good.

Along with the decrease in the growing of tapioca has come an enormous and most striking decrease in pig-raising. The following are the figures for the excess of the exports from Malacca territory of pigs over and above the imports.

Excess Exports over Imports.

1909	...	...	21,564 animals
1910	...	...	13,925 „
1911	...	...	7,640 „
1912	...	...	2,977 „
1913	...	...	106 „

The pigs used to go to feed the tin-mining towns chiefly, and also the adjacent parts of the Federated Malay States. They were raised by squatters who were allowed to establish themselves chiefly in the coconut plantations, and there, to fatten their swine with the 'ampas' or

*In this year under the Crown Lands Ordinance, 1886, the alienation of Crown Land for tapioca was stopped; but the use of tapioca as a catch crop for more permanent crops was not prevented.

refuse of the tapioca industry. Malacca used to have 'ampas' to spare, but now there is a small import of it, which is paid for through the higher price which pigs fetch in the local market. The rise in the price of pork in Malacca town has been about 43 per cent.

The following table gives the excess value of 'ampas' of either exports over imports or imports over exports, for the last five years.

Tapioca Refuse by Value.

Year.	*Excess Exports over Imports.*	*Excess Imports over Exports.*
1909	$12,269	—
1910	8,935	—
1911	4,958	—
1912	4,950	—
1913	...	$187

Gambier has not shown the same tendency to go down in area as has tapioca; on the contrary though many companies have been using it as a catch crop, and are talking about removing it, its area has been relatively steady. The excess exports over imports for the last five years have been as follows:—

1909	23,106	pikuls (133.3 lbs.)
1910	23.365	„
1911	20,227	„
1912	20,983	„
1913	20,060	„

It is stated that expert labour for the boiling it is now difficult to obtain, and that fuel for the purpose is not so conveniently handy as it was; moreover the price is falling. The price of gambier declared in Malacca for export has been on the average

1909	$12.33	per pikul (133.3 lbs.)
1910	12.78	„
1911	13.93	„
1912	13.53	„
1913	10.29	„

Coconuts have extended very little. They are so much grown mixed with fruit trees, that no separate return is possible; and the following figures are of the area under them, fruit-trees, pine-apples and other garden crops:—

1902	36,588	acres.
1903	37,397	„
1904	40,256	„
1905	40,767	„
1906	42,861	„
1907	44,766	„
1908	45,747	„
1909	46,439	„
1910	45,584	„
1911	47,355	„
1912	47,650	„
1913	46,348	„

The Malays, who own most of the trees give them no cultivation, and so little interest that they generally require compulsion for the removing a diseased tree. It was reported, ten years ago that the appointment of an Inspector of Coconuts had brought about an improvement in the state of the holdings, but the position is still unsatisfactory.

Of crops from permanent planting, coconuts are rather unreliable— responding much to reasons, as the following figures of excess exports over imports of copra show :—

1909	...	...	...	39,542 pikuls.
1910	...	...	...	56,222 „
1911	...	...	...	51,932 „
1912	...	...	...	38,834 „
1913	...	...	...	37,022 „

The manufacture of Kabong sugar from the palm *Arenga saccharifera* is decreasing considerably ; and the trees, which are little cared for, although they give the black rope of the country as well as sugar, are much neglected, and often may be seen to stand dead in the Malay holdings along with coconut palms, long after their trunks should have been removed.

The excess exports over imports have been :—

1909	...	...	...	3,722 pikuls.
1910	...	...	...	1,912 „
1911	...	...	...	2,282 „
1912	...	...	...	1,934 „
1913	...	...	...	1,172 „

Sago is made but irregularly in Malacca; and though the raw product has been produced in sufficient quantities for export during the last three years, the manufactured product has been insufficient, as the following figures show :—

	Flour.		*Raw Sago.*	
Year.	*Excess of Exports over Imports.*	*Excess of Imports over Exports*	*Excess of Exports over Imports.*	*Excess of Imports over Exports.*
1909	1,442 pikuls.	—	No trade.	No trade.
1910	269 „	—	No trade.	No trade.
1911	387 „	—	920 pikuls.	—
1912	—	409 pikuls.	4,870 „	—
1913	—	480 „	680 „	—

The area under areca-nuts or betel-nuts has hardly changed; and the output has been fairly steady, except that 1911 was a rather bad year. That year proved a very good one for coconuts and for fruit trees in Jasin was a record year: it is therefore noteworthy that areca-nuts should not have been plentiful in it.

Excess exports of areca-nuts over imports:—

1909	...	...	...	10,282	pikuls.
1910	...	...	...	12,579	„
1911	..	...	...	9,176	„
1912	...	...	...	12,210	„
1913	...	...	...	11,085	„

Ginger, like betel-nuts, was in 1911 less, in the amount exported.

Excess exports over imports of ginger:—

1909	...	...	...	3,907	pikuls.
1910	...	...	...	1,771	„
1911	...	...	...	1,119	„
1912	...	...	...	2,069	„
1913	...	...	...	1,266	„

The export of Pepper has decreased much.

Year.	*Excess Exports over Imports.*	*Excess Imports over Exports.*
1909	159 pikuls.	—
1910	228 „	—
1911	68 „	—
1912	—	81 pikuls.
1913	20 „	—

Padi and coconuts happen fortunately to be the only crop plants which the locusts, *Pathytylus danicus*, have damaged as yet by eating, and this in Malacca only to a slight extent. The insects feed on the coconut leaves; but the padi, they nibble and damage, biting through the haulms but not devouring then; however, the result is as injurious. They were reported as doing damage in this way in the Alor Gajah District, in 1912, and they repeated it in 1913, locally. From other pests the padi has been relatively free. But the crop has suffered from the effect of the removal of forest about the sources of the streams, wherefrom these come in spate after heavy rain and then run low until the next storm. The result has been that the fields near to the central water course of each valley have been flooded out, and are now often in rough sedges. As a remedy it is intended to spend larger sums than usual in removing obstructions from the channels, so that the water may run off freely; but it is doubtful if anything short of tank-irrigation will make the crop what it might be. The extent of the crop has been narrowed, because of the Malay labour drawn off into the rubber estates, but the new reduction of wages operates against a continuance of this. In order to protect those who do plant against the ravages of vermin finding a harbourage on the fallows, pressure is being put on the owners of the holdings, under the Malacca Lands Ordinance, 1886, to make them to cultivate and to make them to keep clean the borders of their holdings. The effect of the pressure was not evident in the returns of area for 1913.

Year.	Area under Rice.	Value of Padi as declared on export.
1902	32,185 acres	—
1903	36,074 „	—
1904	37,369 „	—
1905	37,229 „	—
1906	38,201 „	$2.44 per pikul.
1907	39,067 „	2.57 „
1908	39,497 „	2.66 „
1909	41,198 „	2.29 „
1910	39,997 „	2.29 „
1911	40,410 „	2.53 „
1912	40,260 „	3.53 „
1913	39,040 „	3.23 „

The price of padi has been better than it used to be; and the demand vastly increased, so that export has ceased to be greater than import. This is shown in the following table :—

	Padi.		*Rice.*	
Year.	*Excess of Exports over Imports in pikuls.*	*Excess of Imports over Exports in pikuls.*	*Excess of Exports over Imports in pikuls.*	*Excess of Imports over Exports in pikuls.*
1906	20,617	—	—	251,612
1907	32,473	—	—	250,587
1908	23,309	—	—	279,283
1909	17,492	—	—	261,017
1910	10,606	—	—	316,460
1911	4,193	—	—	382,844
1912	—	8,364	—	462,875
1913	—	3,831	—	436,362

In the opinion of the writer, there is not a crop in Malacca offering more interest at present, than that of rice, nor a crop so deserving of whatever help can be given to it. It appears that hollows in rubber estates, the clean weeding of which costs more than the weeding of rubber land should, would be of greater use to the state as store places for water for rice lands than cultivated and under Hevea. The Malays of Malacca have tried no new crops.

Singapore Island.

The planting of fresh land in rubber continues in Singapore island on a small scale, the area being returned at 34,960 acres.

1904	... ...	78 acres.
1905	... ...	1,110 „
1906	... ...	1,460 „
1907	... ...	4,190 „
1908	... ...	4,745 „
1909	... ...	7,600 „
1910	... ...	20,000 „
1911	... ...	29,150 „
1912	... ...	34,000 „
1913	... ...	34,960 „

The Singapore estates are much more completely planted than the Malacca estates; but their planting commenced on the whole so much later that they are less in bearing: indeed their planting mostly dates back to 1909, although the oldest rubber trees in the island are now in their thirty-fifth year. The year 1913, saw the tapping area on several of the estates increased by about 25-35 per cent., which is an indication that they are rapidly coming into bearing. Just about half of the total acreage in the island under rubber belongs to ten estates; therefore in Singapore, as well as in Malacca, there is a very large area of rubber in private hands. Privately owned rubber trees in Singapore are often packed away among coconuts and fruit trees, according to an oriental method of averaging the risk, and these count far less in the long run than properly planted trees. However, all are generally free from pests and plant diseases.

The ten larger companies hold about 18,260 acres, of which 93 per cent. is planted up.

A cessation from rubber planting appears probable leaving 25 per cent. of the land in the island under it.

Some of the Singapore estates in 1913, had difficulties in realising their estimates, but reached or came very near to them ultimately, though not always without departing from their tapping programme.

There is a little neglected rubber in the island as there is in Malacca.

The catch crop—nurse crop of the estates—has of course, been Pineapples, and now has come the time for cutting them out. The result is a planting of pineapples on new land outside the estates, often with rubber; but the pineapples are more meant than the rubber.

The year 1913, gave the largest crop of this fruit on record—so large that the canneries could not handle the supply, and offered but fifty cents per hundred for the fruit delivered at their doors. At other times in the year the price was as high as six dollars per hundred, similarly delivered. At fifty cents per hundred it hardly pays to cut the fruit. Some of the factories have not had full success with their machinery.

The waste goes to feed pigs—mostly to fatten for killing pigs imported lean from Bangkok and the Dutch Indies.

Tapioca has little hold in Singapore and its largest area in the agricultural statistics of recent years is but 150 acres; it is grown as a vegetable and not for use in mills.

The last indigo in the island, which was grown as a catch crop on the Bukit Sembawang Estate, is being removed.

Coconut palms in Singapore, in 1913, gave a very good crop; but unfortunately they were locally attacked by pests in the later six months, notably by *Brachartona catoxantha* in the north-east of the island. The damage done by these insects will tell on the 1914 crop, and the

Trafalgar Estate estimates a diminution in yield of about 12 per cent., as the consequence of the outbreak on their trees. The outbreak is described above on page 207.

In the centre of the island, and in a less degree towards the south-west, the Palm-weevil was more abundant than it should have been, as the result of the cutting out of coconut palms for rubber. The attack began in both places, in Chinese holdings, and upon the removal of young trees, whose trunks were not destroyed promptly.

The cultivation of coconuts is extending slightly.

In consequence of the extensive consumption of coconut oil in Singapore, the trade statistics do not yield figures showing in any simple way the position of the coconut industry. They show in the first place a diminution in the export of oil with a slight recovery in 1913, thus:—

Year.	*Imports.*	*Exports.*	*Excess of Exports over Imports.*
1906	41,191	168,498	127,307
1907	40,162	159,801	119,638
1908	32,138	149,078	116,940
1909	30,158	135,578	105,420
1910	23,987	99,211	75,224
1911	25,604	98,860	73,256
1912	25,649	81,499	55,850
1913	17,075	85,480	68,405

The price that has drawn the export has nevertheless been increasing since 1908.

Year.	*Price per pikul of the oil as declared on exporting.*
1906	14.89 per pikul.
1907	17.38 ,,
1908	13.49 ,,
1909	14.98 ,,
1910	17.81 ,,
1911	18.50 ,,
1912	19.49 ,,
1913	21.82 ,,

Of copra there is a greater import than export, the figures for the same period being:—

Year.	*Imports.*	*Exports.*
1906	635,385	427,506
1907	927,652	654,869
1908	1,171,039	968,658
1909	1,095,312	918.948
1910	1,335,477	1,319,644
1911	1,246,286	1,161,102
1912	1,122,587	991,448
1913	1,374,201	1,154,122

Assuming that 100 pikuls of copra yield 62 pikuls of oil, and calculating the excess exports of all as copra, we get the following figures:—

Year.	*Excess Imports of Copra.*	*less.*	*Excess Exports of Oil calculated as Copra.*	*leave.*	*Excess Imports calculated as Copra.*	*Excess Exports calculated as Copra.*
1906	207,879		205,334		2,545	—
1907	272,783		192,966		79,807	—
1908	202,381		188,613		13,768	—
1909	176,364		170,032		6,332	—
1910	15,833		121,329		—	105,496
1911	85,184		118,155		—	32,971
1912	131,139		90,981		41,058	—
1913	120,079		110,331		9,748	—

The figures indicate that only in exceptional years does Singapore island produce for export coconut products; but the variation towards either side is extraordinary. The average imports over the 8 years have been 1,113,492 pikuls of copra and of the 6 years, omitting 1910 and 1911, 1,054,362 pikuls; but in 1910—the most fruitful year—there were imported 220,000 pikuls above this—a circumstance to be attributed to the splendid crops, not only of Malacca (which have been mentioned on page 221 above) but of the whole of the east of the Peninsula and of many of the not-remote Dutch Indies. The equivalent of this 220,000 pikuls was re-exported either as copra or as oil, the excess of imports averaging 25,543 pikuls of copra disappeared, and an export equal to 105,496 pikuls occurred. In 1913, the registered imports were higher still; but the tremendous excess export of copra (as copra or as oil) has not been attained.

The average prices of copra declared for export from Singapore have been:—

1906	$8.47	per pikul of 133.3 lbs.
1907	9.79	,, ,,
1908	7.12	,, ,,
1909	8.31	,, ,,
1910	10.30	,, ,,
1911	10.02	,, ,,
1912	10.69	,, ,,
1913	12.73	,, ,,

The areca-nuts in Singapore yielded in 1913 better than in 1912, as the coconuts did, so that there has been an increase of exports; but on the whole they receive little attention. The figures for the last five years are:—

Year.	*Excess of Exports over Imports.*	*Average Price.*
1909	81,612 pikuls	$4.54
1910	136,492 ,,	5.45
1911	86,117 ,,	5.49
1912	18,803 ,,	5.58
1913	23,038 ,,	7.15

Gambier is disappearing from the island. Under Malacca the diminution of its price has been given; and from that cause arises its decrease in Singapore island. Pepper cultivation seems slightly to be increased. Sugar-cane cultivation, for eating only, is unchanged. Rice has not existed in the island for a very long time. The few nutmegs in the island produce a little fruit. A small experimental area has been planted with Cacao.

Durians yielded very well in December, 1913, and so did Rambutans; but the crop of Mangosteens was not good.

The amount of fruit which Singapore imports is now very considerable. The Muar river enjoys a large share of this trade, Sarawak and Síam a not inconsiderable portion in special lines.

The demand for vegetables is so great that their prices are very high. In the island there is a slight increase of vegetable growing—katiang, ladies fingers, brinjals, etc., and a little planting of bananas.

The planting of " Pisang Batu " for leaf plates, leaf wrappers and a substitute for string is extending.

Sweet potatoes are the chief root crop of Singapore; and they are less extensively grown than might be expected. The big alocasia comes next in importance.

With the intention of attempting the introduction into Singapore of a new root-crop the lesser yam (*Dioscorea aculeata*, Lamk. or *D. fasciculata*, Roxb.) was brought in 1913, into the Economic garden: it is a tuber, which constitutes a large part of the food of the labourers in some parts of India, and is, moreover, when suitably cooked good eating: but thereafter it was found that a Chinese cultivator on Holland Road had already commenced the growing of it. It is curious that this plant has not hitherto found a lodgement here, yet has been for a very long time an important food plant in the Eastern Archipelago, and in India. Rumphius, who lived in the Dutch Indies from 1653 to 1702, and became Governor of Amboyna, said, that in his time it was being grown about Batavia by immigrants, who had come from the East; yet Ridley was able to write two centuries later, in 1908, that he had never seen the species nor could find evidence of its occurence in the Malay Peninsula.

Lemon oil grass is still in cultivation and distilling is done on a small scale; but the interest in it has diminished considerably. The Java citronella oil, along with which the Singapore product should sell, is absorbed very readily on the market in Europe, though at a narrow margin of profit.

Penang and Province Wellesley.

The agriculture of Penang shows little change. Nutmeg and Clove cultivation is decreasing; the output of the year has been small.

The coconut and areca nut crops were fairly good. Mangosteens were produced freely, but not in the same plenty as in 1912, when the yield was remarkable. Their lowest price was 3.50 per hundred. An impression gained in Penang is that from planting a few years back, an increase in the production of this fruit will soon follow. Durians fruited normally in 1913. The cultivation of plantains is not increasing. The local vegetable crop seems inadequate, but there is no sign of extension within the island.

The rice crop of 1912-13 was not good; but that of 1913-14 is very good.

The last of the sugar-cane, grown for the manufacture of sugar, has disappeared from Province Wellesley; its place having been taken by rubber. Towards the end an experiment was made on the Central Factory plan, small areas of land being allotted to cultivators who were to cut the crop as required; but it failed, the cane been ill-grown. This is of great interest as illustrating the difficulty, that there would be, in establishing such an institution as a Central Factory in the Province—a difficulty illustrated also by the fact that small holders of the same class often turn out raw tapioca, which is hardly marketable; but such men seem to be more fortunate when they turn their attention to raising crops which require the gardener's skill only; and a considerable number of them, chiefly in the Central and Southern divisions, are raising pineapples, gourds, beans, brinjals, etc., as catch corps among very young rubber or coconuts. These men appear not to be tyring anything new; but in the northern division, in 1913, a small acreage was planted up by Malays with the lesser yam; (see page 227 above) and so great was the profit that it appears as if the culture will become established.

One most interesting new cultivation in the Province, is that of Arrowhead—*Sagittaria saggitifolia*—grown on an extending area of rice-land near Bukit Mertajam, by Chinamen for feeding pigs, and apparently profitable. About three crops are grown in the year.

The fruit trees in the Province in a very large measure want renewing; they are trees which were planted round the country houses of well-to-do Chinese, from whose hands in some cases they have become company-property. But they are now of little value.

There is a trade from Penang to Calcutta of small dimensions in fruit, chiefly in mangosteens and the best plantains, which might be fostered and become something; pineapples, which squatters are growing in the Province, might be exported also.

Rubber in the Province and Penang is credited with the following increasing acreage :—

	Province Wellesley.	*Penang.*
1905	Nil	Nil
1906	4.009	Nil
1907	4,833	50
1908	7,894	550
1909	14,166	1,450
1910	15,501	2,648
1911	24,725	4,094
1912	30,530	5,800
1213	34,766	6,310

The estates of the island and in the Province together cover almost the same area as those of Singapore island, and are almost of the same age. A little later, comparisons will be interesting. But whereas we found a very large amount of privately owned rubber in Singapore, we find very little in Province Wellesley where 70 per cent. of the total area in rubber make parts of 18 estates there.

Only one of these estates is without coconuts: and some are extending by planting the one crop, and some by planting the other, in such a way that rubber has only a small preference over coconuts.

In reserve the estates hold 41 per cent. of their area. If we allow to rubber and to coconuts an equal extension out of this 41 per cent., that is 20 per cent. for each, not much more than 22 per cent. of the whole province seems likely to go into rubber.

The estates have been disappointed in the yield of Coconuts; one estate for instance with 33,000 trees almost all in bearing gave

in 1910-11	1,000,316 nuts.
in 1911-12	670,039 „
in 1912-13	713,658 „

when 900,000 were expected.

The differences are the effect of the seasons, and it is to be feared of conditions, probably chiefly connected with the soil water which we cannot easily control. These conditions make it very hard to estimate accurately the crop in advance; and unfortunately the good year of 1910, to which many of the current estimates date caused expectations to be inflated.

Estates beyond the borders of Province Wellesley have made the same complaint, that the years which followed 1910, disappointed them.

Estates built up out of old Chinese holdings are in some cases planted with different races of coconuts on no system.

Tapioca in the Province seemed at the beginning of 1913 to be extending as it had done in 1912, in spite of a falling price; but the price continued to fall and went so far as to make harvesting unprofitable. Such a large drop is rather calamitous, occurring within the growth of one crop, and the more so as the Province is not only not at the stage in its rubber plantations when catch crops can be generally dispensed with, but has a pig industry dependent largely on the tapioca refuse.

The following is the acreage returned under Tapioca :—

	Province Wellesley.	*Penang.*
1902	10,800	about 150
1903	11,145	about 80
1904	11,145	about 60
1905	12,035	about 60
1906	37,690	about 100
1907	39,165	— 130
1908	14,537	— 110
1909	14,101	— 120
1910	11,006	— 140
1911	9,700	— 170
1912	11,290	— 130
1913	7,785	— 180

The excess of exports over imports of tapioca from Penang have been :—

	Flake.	*Pearl.*	*Flake and Pearl together.*
1909	35,571 pikuls	236,765 pikuls	272,336 pikuls
1910	26,609 „	180,286 „	206,895 „
1911	10,891 „	248,755 „	259,646 „
1912	9,441 „	265,824 „	275,265 „
1913	8,645 „	309,841 „	318,486 „

The excess of exports over imports, or the reverse, of tapioca flour and refuse from Penang have been :—

	Flour.		*Refuse.*	
	Excess of Exports over Imports.	*Excess of Imports over Exports.*	*Excess of Exports over Imports.*	*Excess of Imports over Exports.*
1909	150,648 pikuls.	—	18,239 pikuls.	—
1910	44,948 „	—	8,339 „	—
1911	—	25,097 pikuls	7,212 „	—
1912	27,278 „	—	—	29,368 pikuls.
1913	4,332 „	—	1,027 „	—

So that latterly Penang and the Province Wellesley have used up most, if not all, of the refuse available from the tapioca manufacture.—Moreover the flour, the import of which has never been below 30,000 pikuls per annum, has been the more and more worked up into products for human consumption, thereby liberating more and more refuse for local use.

The pigs which are fattened on this refuse are chiefly exported to Ipoh and other centres of industry, by rail. The excess export over import of them has been :—

1909	... ...	2,527 animals
1910	... ...	5,768 „
1911	... ...	10,802 „
1912	... ...	17,423 „
1913	... ...	16,849 „

That the growth of this trade has marched with the diminution of the excess export of tapioca flour and refuse is evident ; and it is almost certain that the cessation of the abundant supply of tapioca refuse, which in Malacca caused to cease the export trade in pigs, will choke the trade of Penang also, where the price of pork has been rising, as it did in Malacca. Therefore it is earnestly to be hoped that the price of tapioca will rise enough to make its harvesting remunerative, for all three reasons, viz: (1) for the sake of a profit to the grower, (2) for the sake of a business to the manufacturer, and (3) for the sake of a cheap pig food from the refuse. The manufacture of material for industrial alcohol might make the tapioca to pay, where otherwise it does not.

The fall in price of tapioca may be thus illustrated from the Singapore market. The figures are of the price given in the first week of each month as they appeared in the "Straits Times," of December 31st, 1913.

1912.				1913.			
January	9.20	July	9.25	January	7.60	July	5.95
February	8.90	August	9.15	February	7.30	August	5.35
March	9.10	September	9.00	March	7.15	September	5.20
April	9.50	October	8.75	April	6.50	October	5.01
May	9.10	November	7.50	May	6.30	November	4.70
June	9.30	December	7.70	June	6.25	December	4.40

Sago refuse goes to fatten pigs along with the tapioca refuse; and the same absorption of what is available has been going on. The former considerable export of flour has been steadily reduced, as the second column of the following table shows :—

	Imports of Sago Flour.	*Export of Sago Flour.*	*Excess of Exports over Imports.*
1906	30	10,896	10,866
1910	1,672	5,799	4,127
1911	5,816	5,440	(Excess Imports of 376 pikuls).
1912	187	4,568	4,381
1913	83	2,057	1,974

The excess exports over imports of pearl sago over these years have been:—

1909	...	...	96,822	pikuls.
1910	...	...	69,707	„
1911	...	...	79,487	„
1912	...	...	93,273	„
1913	...	...	91,124	„

The excess import of sago flour occurred in the same year as the excess import of tapioca flour, i.e., 1911: it came through Singapore, apparently, as also did the major part of the excess import of tapioca flour, the local area under tapioca having been restricted somewhat. With the expansion again in 1912, of the local area, this excess import was replaced by an excess export.

The Penang poultry trade shows a slightly larger export but a greatly increased import. This import is largely from Kedah, the birds being exported to Port Swettenham, etc. The price of poultry is also rising.

Trade in Poultry Counted by Dozens.

	Imports.	*Exports.*	*Excess of Exports.*
1909	39,559	59,864	20,305
1910	40,318	66,477	26,159
1911	29,090	71,622	42,532
1212	35,646	67,881	32,235
1913	54,913	76,041	21,128

The area under coconuts is not separately returned, but the following figures of the area under fruit trees and gardens indicate both a wide extent and a slight increase in the Province accompanied by little change in the island.

	Province.	*Penang.*
1902	60,000	29,940
1903	60,186	29,946
1904	60,186	29,543
1905	61,295	29,751
1906	62,900	29,730
1907	64,101	29,430
1908	64,122	29,700
1909	63,743	29,226
1910	64,974	30,644
1911	65,692	29,703
1912	66,703	30,030
1913	69,218	30,630

Nineteen estates in Province Wellesley own 14,084 acres of coconuts, of which only just over one quarter is in bearing as yet.

Those apparently extraordinary fluctuations in the trade of Singapore, in coconut products, do not appear in the Penang trade statistics.

	Excess of Exports over Imports of Oil.	*The same calculated as Copra.*	*Excess Exports over Imports of Copra.*	*Excess Exports of Oil and Copra calculated as Copra.*
1909	27,385	44,169	95,280	139,449
1910	27,779	44,790	172,679	217,469
1911	26,433	42,634	126,780	169,414
1912	33,631	54,244	83,497	137,741
1913	29,826	48,106	92,636	140,742

The figures very well reflect the varying crop, which was excellent in 1910, and was again better in 1913 than in 1912. In addition to an export in oil and copra, Penang exports nuts in increasing quantities to Madras and other Indian ports.

Areca nuts which yielded so well in Malacca in 1910, when coconut palms did, behaved similary in Penang. Since then their excess export has fallen somewhat.

	Excess Exports over Imports.
1909	100,463 pikuls.
1910	114,854 „
1911	95,546 „
1912	97,688 „
1913	86,437 „

Although the area under nutmegs and cloves in the Province Wellesley is reported as unchanged, the last nutmeg trees on Bukit Mertajam are now dying; and there seems to be no likelihood of fresh planting there. The plantations in the island of Penang have decreased considerably of late years, and the excess of exports over imports has narrowed, more than seasonal variation accounts for.

Area returned as under nutmegs and cloves :—

	Province Wellesley.	*Penang Island.*
1902	—	10,500 acres
1903	—	10,527 „
1904	—	10,270 „
1905	—	10,070 „
1906	—	9,866 „
1907	100 acres	9,410 „
1908	500 „	9,240 „
1909	664 „	8,930 „
1910	450 „	8,825 „
1911	550 „	6,750 „
1912	500 „	6,310 „
1913	500 „	6,000 „

	Import of Nutmegs into Penang.	*Export from Penang.*	*Excess Exports.*
1909	2,350 pikuls	5,154 pikuls	2,804 pikuls
1910	2,608 „	3,802 „	1,194 „
1911	2,988 „	5,064 „	2,076 „
1912	3,997 „	5,816 „	1,819 „
1913	3,643 „	4,409 „	766 „

Cloves, however, have latterly had fairly good years, so that trade has been :—

	Import of Cloves into Penang.		*Export from Penang.*		*Excess of Exports over Imports.*	
1909	944	pikuls	1,677	pikuls	733	pikuls.
1910	1,276	„	1,419	„	143	„
1911	719	„	2,323	„	1,604	„
1912	475	„	3,981	„	3,506	„
1913	915	„	2,305	„	1,390	„

Penang and the Province consume considerably more pepper than the little that they produce.

The area under rice has been returned as follows :—

	Wellesley.	*Penang.*
1902	48,500	7,700
1903	49,351	7,690
1904	49,351	7,660
1905	49,368	7,660
1906	48,478	7,650
1907	44,456	7,450
1908	45,808	7,530
1909	46,274	7,567
1910	46,138	7,120
1911	45,200	6,129
1912	44,950	6,320
1913	45,977	6,620

The crop of 1912-1913 was not good; but the crop of 1913-1914 proved excellent.

Dindings.

The rubber estates in the Dindings fall into two divisions: one is constituted by the Sandycroft Estate alone; the other consists of four smaller estates near the Lumut river. Sandycroft is celebrated for the large yields that some of its trees used to give, and its land within the Dindings is all planted up. The other estates are extending still. They have land to the extent of 6,079 acres, and have planted 55 per cent. of it.

One of these estates has been depending for development on the profit of tapioca as a catch crop ; and that is failing it now. Tapping of young trees was started in 1912 on one estate, but stopped again when price of rubber fell.

Coconut-groves, land under fruit trees, and garden patches make up about 6,500 acres, nearly half of which is the young, and promising Dindings Coconut Company's Estate on the Bruas river. The seed nuts came from Penang.

The land round the District Officer's house has been used somewhat as an experimental ground to see how various plants grow; but the officers succeed one another at intervals too short for the purpose to be carried out to much effect. Cloves on this piece of land have grown satisfactorily.

Tamil labour is altogether prevalent in the Dindings, and the Tamils show some tendency to try crops of their own land; thus Sesamum, Ragi (*Eleusine Coracana*) and Chillies are to be seen in small patches near Lumut. This tendency seems to afford a possible opening for widening the very meagre list of crop plants of the peninsula.

Rice which was grown some years ago on the northern border, and which went out of cultivation, has been planted again to the extent of about one hundred acres.

CROTON SPARSIFLORUS, Morong,

an American Invader.

Close to the East Wharf in Singapore, near to the Lagoon Dock, and west of the Peninsula and Oriental Steamship Company's wharf, occurs in some quantity on waste ground an American plant by name *Croton sparsiflorus*, whose advent is of some interest. For several years it has been spreading in Bengal and Assam, from the coast inland, in a way which strikingly demonstrates its dependence on man, and also shows that without hooks or barbs on its seeds or stickiness or any other device for attaching them to objects, a plant with an abundant fertility, may get itself spread effectively through trade. Now that it has reached Singapore, and become established, we shall probably witness its steady spread from the new centre along trade routes in Malaya. Nothing eats it; its smell protects it from cattle; and apparently its natural enemies have been left behind in its migration. Fortunately it is not aggressive as a weed, but for the most part confines itself to waste places.

Its home is on the River Plate, and it was first described from Paraguay. Its appearance in the East was recorded in 1905, when Sir David Prain, in an account of the vegetation around Calcutta (Records of the Botanic Survey of India, vol. iii., page 276) stated that it was abundant in waste places to the south of the city, particularly about Diamond Harbour. From a paper published later by Professor P. J. Brühl, (Journal of the Asiatic Society of Bengal, new series, 1908, page 603) we learn that as early as 1901, one of these waste places was within six miles of the city (four miles from the docks), and that in 1903 or 1904, it advanced as far as the waste ground

between the Botanic Gardens and the Bengal-Nagpur Railway Company's goods sidings at Shalimar, whence there is a railway ferry service to the other side of the river Hughli, by which goods waggons are sent over to the docks.

At a later date than the first record, the plant was found to be abundant about Chittagong and to have been there at least since 1898, for Mr. D. Hooper, late Economic Botanist to the Botanic Survey of India, had preserved a specimen collected in October of that year; further Professor Brühl obtained information from one of his students that the plant had been seen ten years before 1907, on the railway line side between Chandpur and Akharara—two stations on the Assam-Bengal railway, which serves Chittagong. Examination of the line about Chandpur in 1908 showed that it had become abundant enough to indicate its establishment several years earlier.

After Calcutta, Chittagong is the second port at the head of the Bay of Bengal; Diamond Harbour and Chandpur are only river stations, where sea-going boats do not discharge cargo; Akharara is a little inland.

The abundance of the plant about Chittagong and Chandpur indicates the east side of the Bay of Bengal to be the one on which it obtained its first lodgement; and the way in which it was observed to approach Calcutta from Diamond Harbour forbids the belief that it was first established on the Hughli. Probably it found a home in the beginning at Chittagong; thence it reached Chandpur along the railway; from Chandpur it was brought to the Hughli by the Sundribans steamer traffic: and now it has reached Singapore, perhaps from Chittagong, but more probably from Calcutta.

Its further spread in India during the last few years has been recorded (Proceedings of the Asiatic Society of Bengal, 1910, page ci.; 1911, page cxxxii.; and 1912, page cxiii). It has appeared at intervals all along the Assam-Bengal Railway from Chittagong to one terminus at Gauhati and beyond the other terminus to Makum Junction, on the Dibru-Sadiya Railway, being always found at places where goods are unloaded: and it has reached Narayanganj near Dacca which is connected with Chandpur by a steamer service. It may be expected to travel along the railway from Narayanganj through Dacca to Jaganathganj slowly, because there is very little through traffic; it is sure soon to reach Goalundo and thereby the Eastern Bengal Railway system; from Calcutta it is likely to travel first towards Nagpur and Madras, and afterwards in other directions along the railways.

There is only one easy way of accounting for the travelling of its seeds; and that is by assuming that they get enmeshed in the gunny wrappings of packages. By reason of the greater use of gunny wrappings in India than in the Malay region, it is travelling faster there than it will in Malaya.

Croton sparsiflorus grows to a height of about two feet or sometimes to three feet. Its stems are woody and rather wiry, a single stem arises from the root, and at a height of about six inches branches into three or four, which again branch repeatedly candelabra-wise. The root system is not extensive; and the plant is easily dislodged. Its leaves are 1-2½ inches long, lanceolate, rounded below, with small blunt serrations, dark green, with stellate white hairs below. The smell of the plant is rather unpleasant.

The flowers are formed on upright open racemes, the females below, and the males above and much more numerous. The axis carries stellate hairs. The female flowers are 2-6 in number with five sepals and small orange-red glands within them, and a tri-carpellary ovary as is characteristic of its order—the Euphorbiaceae. The male flowers are along the axis in clusters of 3-4 or fewer, on short pedicels; they have five sepals, five small white petals, five glands and a bunch of about fifteen stamens rather conspicuous by reason of their white anthers. The seeds are about one sixth of an inch long, coloured and shaped rather like the seeds of the castor oil plant, with a white caruncle and a surface that is only microscopically rough.

I. H. BURKILL.

KENARI SEEDS.

The following Correspondence is printed here for record:—

Imperial Institute, London, S.W.,
16th October, 1913.

SIR,

The Imperial Institute has received a request from a firm of confectionery manufacturers in the United Kingdom for a sample of the fruits or kernels of *Canarium commune*, L., which are stated to be suitable for use as a substitute for almonds.

This tree is said to be grown in the Moluccas for the sake of its fruits, which are also stated to be commonly eaten in Java. It is possible that supplies of the fruits or kernels are obtainable in the Straits Settlements, and if so I shall be very much obliged if you will send me a sample of a few pounds.

I shall also be grateful if you can let me know whether any firm in the Straits Settlements can undertake to export the kernels or fruits, and if so at about what price the product would be quoted.

I am, Sir,
Your obedient Servant,
(Signed) WYNDHAM R. DUNSTAN.

The Director of Gardens, Singapore.

Botanic Gardens, Singapore,
31st January, 1914.

SIR,

In response to your letter No. 3102/1913, dated 16th October, 1913, I have the honour to send to you a small consignment of the seeds of *Canarium commune.*

These seeds are imported into Singapore and sold at one cent a piece for eating. It is unlikely that any firm of merchants here could find a trade in them to their profit. Nevertheless I should value any report that you care to make upon these seeds as we might try to bring in the tree as a fruit garden tree. Similarly I should value any report which you may be willing to make upon seeds, to follow, of *Canarium rufum* from those gardens, where it fruits freely and where the Chinese 'amahs' pick them up and eat them.

I have the honour to be, Sir,
Your obedient Servant,
(Signed) I. H. BURKILL,
Director of Gardens, S.S.

The Director,
Imperial Institute,
London, S.W.

No. 1110/1914.

Imperial Institute, London, S.W.,
7th April, 1914.

SIR,

I have the honour to enclose a report on a sample of *Canarium commune* seeds which was forwarded to the Imperial Institute by the Director of Gardens at Singapore, with letter dated 31st January, 1914

I have etc.,
(Sd). THOMAS A. HENRY,
for Director.

H. E. the Governor,
Straits Settlements.

IMPERIAL INSTITUTE.

Result of the examination of seeds of *Canarium commune* from the Straits Settlements.

Imperial Institute No. 52434, dated, 7th April, 1914.

REFERENCE.—Letter dated 31st January, 1914, from Director of Gardens at Singapore.

NUMBER OF MARK AND WEIGHT OF SAMPLE.—Seeds of Canarium commune. Weight 1½ lb.

DESCRIPTION.—Seeds or nuts measuring about 1⅜ inch in length and ⅞ inch in diameter, somewhat resembling Spanish chestnuts in shape, and pale brownish grey to dark brown in colour. The shells were about ⅛ inch in thickness, and very hard.

The nuts consisted of shell, 87.1 per cent.; and kernel, 12.9 per cent. Most of them contained at least 2 kernels (about 30 per cent. contained 3 kernels), but a few contained only one. The kernels had a chocolate-coloured coat, enclosing a cream-coloured interior which had a pleasant oily taste.

The kernels were analysed with the following results:—

RESULTS OF EXAMINATION EXPRESSED ON MATERIAL AS RECEIVED.—Moisture ...	...	per cent. ...	... 2.9
Crude proteine ...	...	„ „ ...	... 13.5
Consisting of			
True proteins ...	...	„ „ ...	12.9
Other nitrogenous substances ...	...	„ „ ...	0.6
Fat ...	...	„ „ ...	... 72.3
Starch, &c. ...	...	„ „ ...	... 7.4
Fibre ...	...	„ „ ...	... trace
Ash ...	...	„ „ ...	... 3.9

NUTRITIVE VALUE.—Nutrient ratio:—(the ratio between the percentage of crude proteins and the sum of the percentages of starch and fat, the latter being first converted into its starch equivalent) ... 1 : 12.3

FOOD UNITS:—(the total obtained by adding the percentage of starch to 2.5 times the sum of the percentages of fat and crude proteins) ... 221.9

COMMERCIAL VALUATION AND REMARKS.—The kernels of these nuts have a very high food value, and the proportion of fat is large, viz., 72.3 per cent. as against 65 per cent. in the case of walnuts, filberts and hazel nuts. The difficulty of breaking the shells would, however, prevent the use of the nuts in Europe for dessert purposes.

If the nuts were shelled locally and the whole kernels alone exported in good fresh condition, the product might perhaps find a market in European confectionery; but the kernels have no special advantage in taste over the kinds already used for this purpose, and as the nuts yield only 13 per cent. of kernels, the extraction might be unremunerative at the price obtainable.

RAINFALL

at the Director's house, Botanic Gardens, Singapore, during the second half of the year, 1913.

Readings taken always at 8 a. m. and credited to the date in which the twenty-four hours begin.

Day.	July.	August.	September.	October.	November.	December.
1	...	...	...	0.10	0.37	0.42
2	0.81	0.01	...	...	0.07	0.27
3	0 02	...	0.17	...	0.84	0.27
4	...	0.24	..	0.01	0.32	...
5	0.20	Trace	0 82	1.38	Trace	0.26
6	...	0.07	1.02	...	Trace	0.16
7	0.31	...	1.03	0.06	...	0.12
8	0.36	...	0.20	Trace	1.30	0.49
9	0.11	0.64	...	...	0.62	...
10	0.20	0.30	0.40	...	0.29	0.01
11	...	Trace	0.78	...	0.21	0.05
12	...	0.27	0.76	0.03	1.73	0.20
13	1.08	...	...	0.58	0.02	0.27
14	...	0.14	...	0.03	1.25	0.49
15	...	...	0.33	0.96	0.21	3.20
16	...	0 08	0.71	0.27	1.47	Trace
17	Trace	...	0.02	0 21	0.07	0.33
18	...	...	0.30	0.76	0.24	Trace
19	0.11	...	...	..	1.83	...
20	0.02	...	0.03	1.76	Trace	0.06
21	...	0.43	0 32	1.27	..	0.10
22	...	....	0.03	0.22	0.23	0.01
23	...	...	0.06	0.06	0.13	1.04
24	...	0.04	0.72	...	0 29	Trace
25	...	0.02	0.17	0.81	...	Trace
26	...	...	0.03	1.40	0.31	0 06
27	0.02	...	Trace	0.41	2.06	0.11
28	0.01	0.07	...	0.20	0.52	...
29	3.25	...	...	0.03	0 26	..
30	Trace	...	...	0.02	Trace	0.33
31	...	...		1.95		..

RAINFALL

at the head of the Waterfall Gardens, Penang, during the first half of 1913.

Rainfall read at 8 a m. and credited to the day in which the twenty-four hours begin.

Day.	January.	February.	March.	April.	May.	June.
1	0.02	...	...	0.03	...	0.23
2	0.03	...	...	1.15	2.90	0.18
3	...	...	0.07	0.18	0.98	0.16
4	1.21	...	0 04	...	1.59	0.05
5	...	...	...	0.19	2.10	0.64
6	...	...	...	...	2.05	0.01
7	...	0.07	...	0.58	0.42	...
8	...	...	...	0.28	0.15	0.03
9	...	...	...	0.18	2.40	2.13
10	0.05	0.42	0.10	0.04	1.54	0.04
11	1.67	...	0.39	0.84	0.34	...
12	0.41	...	0.04	...	...	...
13	0.35	...	0.15	...	2.50	...
14	0.03	...	1.33	...	0.02	...
15	0.10	...	...	...	0.58	...
16	0.50	...	0.32	0.19	1.72	...
17	...	...	0.41	0.17	...	...
18	0.14	...	0.27	0.22	...	0.67
19	...	...	...	...	1.08	...
20	...	...	0.30	...	0.22	1.30
21	...	...	9.09	0.44	0.03	...
22	...	...	1.05	0.17	0.02	0.05
23	...	...	...	...	0.04	...
24	...	...	0.17	0.06	...	0.35
25	...	...	0.23	Trace	...	...
26	...	0.35	0.56	0.36	0.03	...
27	...	...	...	0.02	...	..
28	...	0.10	...	0.07	...	0.11
29	...		...	0.05	...	1.30
30	...		...	0.41	0.10	0.59
31	...		...		0.09	

RAINFALL

at the head of Waterfall Gardens, Penang, during the second half of 1913.

Day.	July.	August.	September.	October.	November.	December.
1	0.03	...	0.03	0.01	1.14	...
2	1.07	...	...	0.50	0.08	0.04
3	...	0.05	0.52	0.09	0.32	0.22
4	0.14	0.05	0.03	0.13	0.16	0 80
5	0.30	0.18	0.22	0.06	0.86	0.03
6	1.85	0.16	0.44	0.02	0.03	0.03
7	0.33	0.80	0.05	1.59	1.27	0.14
8	1.70	0.12	...	0.04	1.96	0.03
9	0.12	0.73	0.42	0.41	0.66	...
10	0.03	...	2.54	2.04	2.74	0.08
11	...	...	0.30	0.47	3.28	0.40
12	...	0.70	2.70	0.60	1.39	0.02
13	...	0.65	4.30	1.34	0.08	0.05
14	0.48	...	1.03	2.24	0.26	0.04
15	0.53	...	2.35	1.75	0.02	0.26
16	0.13	0.09	...	1.76	...	0.92
17	...	0.02	0.12	0.36	1.14	0.22
18	...	0.03	0.04	0.38	0.43	0.03
19	...	0.03	0.02	2.04	0.40	1.60
20	...	0.05	0.08	0.42	0.15	0.02
21	0.26	1.04	4.41	1.67	...	...
22	...	...	3.40	0.08	1.47	0.49
23	0.08	...	0.55	1.03	0.02	0.09
24	...	0.10	3.22	...	...	...
25	0.02	0.39	0.55	...	0.14	0.06
26	...	0.07	1.03	1.50	0.55	0.05
27	0.17	...	...	0.07	0.91	0.08
28	...	0.18	...	1.80	0.20	...
29	...	0.06	0.03	0.01	0.13	...
30	...	...	...	1.60	0.08	0.07
31	0.06	0.08		0.02		0.03

Registered by the

Municipality of George Town.

SUMMARY OF RAINFALL, 1913.

	SINGAPORE (See p. 198).			PENANG			Rain fall in 1911 and 1912, at the head of the Water fall Gardens, Penang.	
	No. of rainy days.	Amount of rain in inches.	Longest Spell without rain.	No. of rainy days.	Amount of rain in inches.	Longest Spell without rain.	1911.	1912.
January	not recorded			11	4.51	19	2.19	1.37
February	partly recorded.			4	0.94	19	1.47	1.38
March	18	18.70	3	16	5.52	5	6.27	3.33
April	17	9.99	3	21	5.63	4	9.52	5.57
May	22	9.19	2	22	20.91	3	10.59	17.17
June	25	16.46	1	16	7.84	7	10.10	10.67
July	15	6.50	6	17	7.30	4	3.05	4.56
August	14	2.31	5	21	5.58	2	8.98	19.54
September	20	7.80	5	24	28.35	2	12.41	17.36
October	23	12.51	3	29	24.04	2	12.49	16.65
November	27	14.64	1	27	19.87	1	9.83	12.46
December	25	8.25	2	25	5.80	2	4.22	6.87
Total in year	—	—	—	233	136.29	—	91.12	116.93
in 10 months	206	106.35	—	—	—	—	—	—

Greatest amount in 24 hours.	6.62	4.41
„ „ 48 „	10.87	7.81
„ „ 72 „	12.68	8.36
Excessively rainy periods, more than 5.00 having fallen in 72 hours. - - 1 (March)		5 (May, Sept., Oct., Nov.)
No. of days when condition existed - 3 „		13
Periods of Comparative drought, less than 0.02 having fallen in 120 hours - 6 (Feb., Jul, Aug., Sept., Oct.)		6 (Jan., Feb., Mar., Jun.)
No. of days when condition existed - 15		33

A SPADIX IN THE AXIL OF THE SPATHE OF XANTHOSOMA.

In making preparations of the flowers of *Xanthosoma* ? *violaceum*, Schott, for the Singapore herbarium, an interesting abnormality was detected, for in a large spathe two spadixes were found, the position of the second being that of a branch in the axil of the spathe. The spathe in question was 17 inches long; the normally present spadix 12 inches long: but the abnormally produced spadix was only three inches, being too short to pass beyond the constriction of the spathe which had forced it into a curve. Its flowers were younger than those of the normally produced spadix, but apparently normal. On their lesser age rests an argument supporting the view that the abnormally produced spadix is a branch in the axil of the spathe; for if were not of a lower order than the normal spadix its flowers ought to be of the same age.

The abnormal specimen is part of No. 276 now in the Herbarium of the Botanic Gardens.

I. H. BURKILL.

GRAMMATOPHYLLUM FLOWERING IN JANUARY.

In the Agricultural Bulletin of the Straits and Federated Malay States, VI., 1907, page 49, Mr. H. N. Ridley recorded the flowering of *Grammatophyllum speciosum*, Blume, in the Botanic Gardens, in January of that year, the usual flowering in August and September having been omitted in 1906. The same phenomenon has been repeated; for this orchid did not flower in 1913, but flowered in Singapore very freely in January and February, 1914. It was seen to be in flower in the Kukob district of Johore at the same time. In Penang it flowered as usual in July and August, 1913.

I. H. B.

SOME PERTINENT PUBLICATIONS.

THE IMPERIAL BUREAU OF APPLIED ENTOMOLOGY. "In the summer of 1911, when the Prime Ministers of the Self-Governing Dominions were present in England, they were invited by the Secretary of State for the Colonies to discuss with the Entomological Research Committee (appointed by the Colonial Office, in 1909), certain proposal for furthering and co-ordinating the investigation of injurious insects throughout the Empire. By this meeting it was unanimously agreed that the establishment of a central organisation for this purpose was desirable, and consequently a tentative scheme was submitted for the consideration of the Colonial Governments concerned.

At a further conference, held at the Colonial Office, in August, 1912, the matter took more definite shape and it was proposed to form an Imperial Bureau of Entomology, to be supported by contributions from the various Dominions and Colonies, as well as from the British Government. The principal functions of this Bureau were to be to collect and co-ordinate all information bearing upon injurious or useful insects; to organise a system for securing the authoritative identification, with reasonable promptitude, of all insects of economic importance submitted by officials connected with the Departments of Agriculture or Public Health throughout the Empire; to compile gradually a comprehensive card-index to the whole literature of the subject, and to publish monthly the "Review of Applied Entomology," which is intended to give an up-to-date epitome of the current literature." (Preface to the Review, No. 1.)

There has been issued newly a report on the work of the Committee, dated 17th December, 1913, which records great progress towards permanent utility. The Review in two series: Series A, Agricultural, and Series B., Medical and Veterinary—has now appeared for more than a year, the parts of series A. costing ninepence each and the parts of series B. sixpence. The working value in distant centres of this Review is very considerable.

HAMEL SMITH, H., AND PAPE, F.A.G., COCONUTS, THE CONSOLS OF THE EAST. Second edition, London (1914). Tropical Life Publishing Depot., Pp. lxviii and 644 with many illustrations. Price 11 shillings net, post free.

The first 400 pages of the second edition of this work are almost exactly as those of the first edition, but the remaining part of the book is much altered,—slightly by omissions, greatly by additions. Of the added matter the most interesting pages are those where the opinions of several competent authorities are brought together in a discussion of the cost of making copra. This industry to date in various lands is discussed. Recent developments such as the use of explosives in agriculture find a place; Dr. Friederichs coconut-beetle fungus is described. But the part of the book dealing with insect pests should have been made fuller and have been well illustrated.

ZIMMERMANN, A., DER MANIHOT-KAUTSCHUK, SEINE KULTUR, GEWINNUNG AND PRAPARATION, Jena (Gustav Fischer), 1913, pp. 1-342, with 151 figures in the text. Price nine marks, unbound; ten marks, bound. This book gives a very complete account of the rubber-yielding species of Manihot. The author is Director of the Imperial Agricultural Institute of Amani, German East Africa, in which country their cultivation has been taken up more than in any other, and where he has been at work on them for at least ten years.

The figures in the book are originals from the author's photographs or from drawings made for him. The text covers the

whole matter of Ceara rubber—the differences between the species, their rates of growth in all parts of the world, their enemies (chiefly in German East Africa), their tapping, the coagulation of the latex and the return.

On page 154, the author gives his opinion cautiously to the effect that the nutritive rôle of latex cannot be considered as proved; on page 224 he advises that trees should not be tapped until their girth is 40 cm. (nearly 16 inches); on page 33 he shows that in favoured localities this girth is reached in a little over a year, but even 3-4 year old trees should not be tapped oftener than 25-40 times in the year, meagre yields having apparently in the past been due to tapping in excess (page 230); and (page 308) the yield which may be hoped for is:—

in the fourth year,		50	kilogrammes	per	hectaire or 44.6	lbs. per acre.
fifth	„	100	„	„	89.2	„
sixth	„	150	„	„	133.8	„
seventh	„	200	„	„	178.4	„
eighth	„	200	„	„	178.4	„

He records as actually obtained on the Kwamdoro estate, whose situation seems to be particularly favourable:—

Year.	*Kilos per hectaire.*	*lbs. per acre.*	*Grammes per tree.*	*lbs. per tree.*
4th	60	53.5	100	just under $\frac{1}{5}$ lb.
5th	120	107.6	200	$\frac{9}{20}$ lb.
6th	200	177.8	333	$\frac{7}{10}$ lb.
7th	220	196.1	367	just above $\frac{3}{4}$ lb.

The seed contains nearly 30 per cent. of oil.

KOORDERS, S. H., EXCURSIONSFLORA VON JAVA, UMFASSEND DIE BLUTENPFLANZEN, Jena, Gustav Fischer. Three volumes, pp. xxvi—412; 742; x-498; with figures in the text, 19 plates and 3 maps; 1911-1912. Vol. iv. to be complete in twenty parts, containing reproductions from photographs and line figures of the higher plants of Java, Part 1, 1913.

This work when complete will be the best substitute for a popular Flora of the Malay peninsula that can be recommended, provided that the possessor can read German. Having but little knowledge of botany it will be possible to ascertain the name with considerable ease of any Javanese flowering plant, and of most of the commoner plants of the peninsula. An unfortunately rather long list of corrections has been issued.

MESSRS. C. L. GATIN AND C. M. BRET in a paper in the COMPTES-RENDUS DE L'ACADEMIE DES SCIENCES DE PARIS, clvi. pp. 805-807, point out that all the varieties of *Elaeis guineensis*—the African oil palm—produce on the Ivory Coast (West Africa) two kinds of fruits, the lesser being empty. They say that these lesser sterile deceptive shells are constant in proportion for each variety, being most numerous in var. *ceredia*, so that they appear to be normal to the trees.

The

Gardens' Bulletin

STRAITS SETTLEMENTS,

into which is incorporated all that has been published as the third series of the Agricultural Bulletin of the Straits and Federated Malay States.

Vol. I. Issued June 22nd, 1915. No. 8.

CONTENTS.

PAGE.

The Treatment to which the Para-Rubber Trees of the Botanic Gardens, Singapore, have been subjected - - - - - 247

Early Distribution of Para-Rubber Plants - 252

Table I Understand "Days" after each Numeral 270

Table II - - - - - - 286

Table IV The Gardens' Seed-Bearers - - 292

Table V The Gardens' Seed-Crop - - 293

Table VI - - - - - - 294

To be purchased at the Botanic Gardens, Singapore from Messrs. Kelly and Walsh, Ltd., No. 32 Raffles Place and 194 Orchard Road; and the Straits Times Office, Cecil Street, Singapore.

DEPARTMENTAL NOTICE.

A few plants of the Avocado or Alligator Pear—*Persea gratissima,* and a few plants of the Brazil nut—*Bertholletia excelsa*—to be sold within the Peninsula at fifty cents each.

It is hoped within a few months to be able to supply—*Eucalyptus corymbosa*—at the same price.

Seeds of *Hevea brasiliensis*--Para Rubber—as available from little tapped trees, twenty-eight years old, to be sold at fifty cents per hundred.

THE

GARDENS' BULLETIN,

STRAITS SETTLEMENTS.

INTO WHICH IS INCORPORATED ALL THAT HAS BEEN PUBLISHED AS THE THIRD SERIES OF THE AGRICULTURAL BULLETIN OF THE STRAITS AND FEDERATED MALAY STATES.

The Gardens' Bulletin is published as material becomes available. Its price is fifty cents a copy, post free, or in advance for a volume of twelve numbers, post free,

Five dollars in the Straits and Federated Malay States.

Nine and a half rupees in India and Ceylon.

Thirteen Shillings in Europe.

Subscriptions paid to the third series of the Agricultural Bulletin, Straits and F. M. S., are counted as subscriptions to it.

SINGAPORE :
THE STRAITS TIMES PRESS, LIMITED.

Rubber Tree No. 2, Economic Gardens, Singapore.

THE

GARDENS' BULLETIN,

STRAITS SETTLEMENTS.

Vol. 1. Issued June 22, 1915. No. 8.

THE TREATMENT TO WHICH THE PARA-RUBBER TREES OF THE BOTANIC GARDENS, SINGAPORE, HAVE BEEN SUBJECTED.

An attempt is being made in the Botanic Gardens, Singapore, to mark down among the old trees the best that they may serve as parents for improved stock. The work of selection will cover many years, and be in some degree tedious; but there is every reason to expect that it will prove worth all the time that may be absorbed. *Hevea brasiliensis*, the Para-rubber tree, in Malaya, shows much variability, and therefore a promise that the general average of the trees can be raised; and moreover not only do we observe this variability here with our own eyes; but we have the assurance of Monsieur Labroy and others that in Brazil great variability can be seen. The work in hand commences with the comparison of tree with tree as judged by the amount of latex given. Were our trees all virgin, this comparison would be facilitated; but they have been subjected to treatment in various ways; and though we do not know as yet, what the effect of tapping is on the life and functions of a rubber-tree, it becomes necessary that in the task before us the past of the selected parents should be known. With this object in view the following record has been compiled from all available sources.

One tree in the Gardens, No. 27, in the year 1904, was recognised as yielding a far greater amount of latex than any of its neighbours, even than those which seemed to have a position quite as advantageous. But it has never been used as a special seed bearer. It and other good trees are now being picked out as parents for the next generation.

A large map of the rubber ground has been prepared, whereon is marked the position of every tree, and wherefrom whenever necessary it can always be ascertained if a selected parent has had an advantageous position or has not.

Unfortunately the tapping records have been unequally kept. In the early days, from 1889 to 1902, they were hardly kept at all. From 1902 to 1903, public interest having been aroused, notices of what was being done in the Botanic Gardens appeared in the local press. From 1904 onwards, they were almost completely kept. Using all the materials which have come to hand, a manuscript record has now been made which shows the nature of the tapping and how it was intermitted in the case of each tree; and the following account largely abridged therefrom avoiding details gives in one view what has happened in the plantation. It, together with the register of the trees and the map above named, serves as the basis in the work to be undertaken.

The failure in 1876, of the first consignment from Kew of Hevea seedlings, fifty in number, to reach the Botanic Gardens, Singapore, alive, has been asserted repeatedly, apparently on the ground of a statement in the Report of the Royal Gardens, Kew, for 1876, which says "the cases did not come into the hands of the Superintendent of the Botanic Gardens . . . . . until the plants were nearly all dead": but when the Report of the Royal Gardens, Kew, for the year 1877 is consulted part of a letter from the Superintendent of the Singapore Gardens is found stating that the Heveas sent in 1876 were making good growth (vide Petch in *Annals of the Royal Botanic Gardens, Peradeniya*, v., 1914, p. 440). So some were saved for at least a year: but no records exist showing their further history. If they lived, they introduced into the Colony plants whose origin was certainly from seed collected by Mr. Wickham on the plateaux between the rivers Tapajos and Madeira; for Kew was distributing these in 1876. Twenty-two seedlings, a second consignment, sent a year later, arrived safely in June, 1877, and more than half of the number were planted out in the Botanic Gardens,—the exact site unknown,—to be replanted in 1878 in what is now the Palm-valley of the Botanic Gardens, then the Economic Garden, where they made poor growth. The other nine were taken to Kwala Kangsar and planted there behind the Residency by Mr. J. H. Murton, the Superintendent of the Gardens in Singapore (vide *Annual Report, Botanic Gardens, Singapore*, for 1878, p. 3; and *Agricultural Bulletin of the Straits and F.M.S.*, ii., 1903, p. 3).

A third consignment is said on the authority of members of the staff of the Royal Botanic Gardens, Ceylon, (e.g., Wright in *Willis, Bamber and Denham, Rubber in the East*, 1906, p. 19) to have been despatched from Colombo for the Singapore Botanic Gardens, in 1877; but its arrival in Singapore is not recorded. Moreover as it was in 1878 and not in 1877, that Thwaites, then Director of the Royal Botanic Gardens, Ceylon, began to send out plants of his own

Photo by] [*H. Overbeck, Esq.*

Hevea brasiliensis, tree No. 174 in the Economic Garden, showing scars of tapping done in 1904.

Photo by] [*Mrs. E. M. Burkill*, 1913.

The path in the Economic Garden between the rubber trees planted in 1886 (on the left) and those planted in 1879. The two most conspicuous trees are Nos. 1 (behind the board) and 2.

propagation, the date appears to be too early for any consignment from those Gardens. That an entry of the despatch of rubber plants from Peradeniya exists in the departmental records seems a fact, but may it not relate to the second consignment from Kew which would pass through Ceylon on its way eastward?

To the charge of the Superintendent of Gardens in Singapore was added in 1879 by the Colonial Government the land which now is the Economic Garden. At the time of being handed over the low-lying part was an indigo plantation, and the hill-slopes above it vegetable gardens cultivated by Chinese, while the hill-top was a more-or-less neglected stretch of secondary jungle (blukar). To the junction of the indigo with the vegetable gardens, Mr. W. Fox, now acting for Mr. N. Cantley who had succeeded to the post of Superintendent but been taken ill, transferred from the Palm-valley the still surviving Para-rubber trees that had been planted by Murton, placing them in a single line. The reader should turn to the first plate in the *Agricultural Bulletin of the Straits and F.M.S.*, II., 1903, for an illustration of these trees at twenty-seven years of age, and to the opposite plate for those still standing in 1913. One of the central trees, No. 5, had died in 1904; and from it, death spread in either direction along the line until in 1913, four trees alone stood; and now there are but three.

It has always been accepted latterly that the parents of these trees grew, in Brazil, on the upland plateaux over the valley of the Tapajos river, whence the seed was collected for the Government of British India, by Mr. H. A. Wickham. But to those in authority in Singapore, in 1878, it was not known with certainty what had been the origin of the stock; and as another of the collectors of Para-rubber seed and plants, Mr. Cross, had officially recommended lands subject to inundation as suitable (vide his letter to the India Office, dated 29th. March, 1877, which may easily be read in Ferguson's *All About Rubber*, 2nd. edition, 1887, p. 59), his descriptions of the flooded lowlands where the Para-rubber tree grows in the Amazon valley were allowed to weigh in the selection of a damp site for the trees (*Annual Report, Botanic Gardens, Singapore*, for 1878, p. 3); and after Murton had expressed himself disappointed with the result, of this first transplanting, Mr. Fox gave them a still damper position. Mr. Fox, who had personal acquaintance with Mr. Cross, and had learned from him the condition of the country near Para, informs the writer that the growth of the trees was much improved by the second transfer.

Cantley at first had no great opinion of Hevea. He wrote in 1885 of the trees in his charge that they "grow well; but in a country where the best rubbers grow wild, it is somewhat superfluous to refer to foreign species, the ultimate success of which may be doubtful." Beyond giving to the trees a little general care, he did nothing to them; and as he was not supplied with funds for the cultivation of the Economic Garden, scrub began to swallow up the lands that had been in cultivation.

It was otherwise in Ceylon. Attention to rubber had been forced on to the Ceylon Botanic Gardens; for on the recommendation of Sir Joseph Hooker, and with the advice of Sir Dietrich Brandis, the India and Colonial Offices had agreed that a big nursery of Para-rubber seedlings should be made in Ceylon to save the situation for India, and enable experimental plantations to be established in Burma as well as in other parts of the Indian Empire. It may be explained that the climate of Calcutta had been tried and found unsuitable, with the first available seedlings, from seed collected for Mr. J. Collins by a Mr. Farris at Cameta, which is to the south-west of Para at some distance (vide *Agricultural Bulletin, Straits and F.M.S.,* ii., p. 2. and Petch in the *Annals of the Royal Botanic Gardens, Peradeniya,* v., 1904, p. 438): they had "utterly failed," Sir George King stated in his *Report of the Royal Botanic Gardens, Calcutta for 1880-81;* and thereupon, as India in other damp regions was ill-equipped with botanic establishments, and in order that the already big outlay should not be lost, Ceylon was asked to find in its humid lowlands some counterpart of the Amazon's forests, where the nursery could be established. Sir Clements Markham (vide *Peruvian Bark,* London, 1880, p. 466) accused the Government of India of being lukewarm, whereas other sources of information show that the India office tried to work apart from Kew, to collect seeds and despatch them independently, and not being competently staffed failed; but in taking the decision to utilise the resources of Ceylon there was nothing but wisdom; and Ceylon became by it at once a new source of wealth to the East.

Under the charge of a gardener named W. Chapman, 1919 seedling Heveas had been sent to Peradeniya in October, 1876, and in the next year the greater part of them were planted out in a purposely acquired plantation at Heneratgoda, on the railway, not very remote from Colombo. All these plants came from the seeds collected by Mr. Wickham on the plateaux over the Tapajos river.

Ceylon received in 1877 a further hundred plants from Kew. Dr. H. Trimen who two years later, *i.e.*, in 1879, succeeded in the post of Director of the Ceylon Gardens, wrote in 1881 (vide *Tropical Agriculturist,* of October 1st, 1881, p. 399) that of 1080 seedlings brought to Kew by Mr. R. Cross without soil, scarcely three per cent. were saved and one hundred of the number transmitted to Ceylon. It is assumed that Trimen in this place referred to the consignment of 1877; and if what Ceylon then received was from Cross' seedlings, then the Singapore consignment of the same date might also be of Cross' collecting, and not from Wickham's seeds. In which case the current view that the old Singapore trees had their origin over the Tapajos valley would be shaken, for Cross collected near the town of Para and on the island of Marajo. The then-Director of the Royal Botanic Gardens, Kew, quoted Trimen's statement without comment in 1898 (vide *Kew Bulletin,* 1898, p. 253); but there is strong reason for believing Trimen mistaken. In the first place Thwaites shortly before his retirement was hardly able to cope with the work which

fell to him and let the records fall into an incomplete state, so that corroboration for the statement cannot be found in Ceylon. In the second place the Kew records, which must be supposed accurate, show that Kew had not 100 plants from Cross' collection in a condition fit to send, and has recorded no such sending. In the *Kew Bulletin*, 1914, p. 164, Sir David Prain writes, that of the 1,080 seedlings without soil which Cross deposited at Kew, on November 23rd, 1876, 680 were sent to Mr. William Bull, the horticulturist, (and their condition on sending is carefully recorded) whereof he saved 14; and 400 were retained at Kew, whereof 3 per cent. were saved alive. Thus about 26 plants alone remained of Cross' collecting; and after recording this the Director of the Royal Gardens says, that there is no entry in the Kew archives which can be interpreted as implying that any of the saved plants ever grew strong enough to be sent to Asia.

It seems then that the accepted origin of our Singapore trees, viz., the plateaux over the Tapajos is correct; and not only is this so, but all seeds and seedlings subsequently obtained from Ceylon to augment the Singapore Gardens' plantation were no more than of the same stock; for Ceylon also had no other.

Thwaites, Director of the Botanic Gardens, Ceylon, in 1876, following a lead given by Kew found means of increasing his supply; for he discovered that he could take cuttings from the seedlings, by using the side branches; and it has been recorded that in 1878 and 1879 he raised and distributed a large number. Mr. Petch (*Annals of the Royal Botanic Gardens, Peradeniya*, v., 1914, p. 460) asks, however, whither went the 1500 plants from the original stock whose disposal in unrecorded unless they were sent out with (or as) cuttings; and it is evidently possible that the Conductor of the Heneratgoda plantation packed and despatched original stock, Thwaites living at a distance being under the impression that cuttings were going out and recording the despatch as such. Moreover Mr. Petch quotes a statement made by Trimen in 1881 to the effect that propagation by cuttings was "extremely difficult and that out of many thousand attempts a very small number" had "succeeded," which throws doubt upon the raising of such large quantities of cuttings as Thwaites' despatches would demand. It is recorded that he sent 500 of these cuttings (we may substitute the word plants for cuttings) to Mergui, a few to Perak, and others (but without success resulting in cultivation) to Madras, Calcutta and Assam. A few years later cuttings (? plants) were sent to the Andaman islands.

The same method of propagation was tried in Singapore and at Kwala Kangsar, but with small or no success (vide *Annual Report, Botanic Gardens, Singapore*, for 1878, p. 3; for 1879, p. 4; and for 1881, p. 4).

The following table gives the early wanderings of Hevea in Asia:—

Early distribution of Para rubber plants.

1876. 1,919 plants from Kew to Peradeniya, Ceylon; 18 plants to Buitenzorg; a consignment which may have failed ultimately to Singapore.

1877. The greater part of the consignment in Ceylon planted out at Heneratgoda. 22 plants to Singapore from Kew, of which some taken to Kwala Kangsar; 4 to Buitenzorg; 8 plants to Mergui, (from Kew) via Calcutta.

1878. Plants sent to Brisbane from Singapore; 500 from Ceylon to Mergui; others to Malabar.

1879. ? plants to the Malay Peninsula, from Ceylon.

1880. 2 plants from Ceylon to Travancore.

1881. 28 plants from Ceylon to the Andaman islands; others to Johor.

1882. Plants from Ceylon to British North Borneo.

1883. Seeds from Singapore to Sarawak and Kwala Kangsar: 27 stumps from Ceylon to Malabar; 12 to Mr. Davidson in Singapore.

1884. 26 stumps from Ceylon to Malabar, and also seeds.

1885. 300 seeds from Ceylon to Malabar; 400 to Singapore.

1887. Seeds from Ceylon to Mergui and to Malabar, and also to Penang and N. Borneo; seeds from Kwala Kangsar to Taiping.

1888. 11,500 seeds from Ceylon to Singapore and to Kwala Kangsar; 3,000 seeds from Ceylon to Central India.

The very first tree to flower in the East seems to have been one of those which were taken by Murton to Kwala Kangsar; for it is recorded that a tree there flowered in March, 1880, at the age of 3½ years.* Another flowered at Heneratgoda. In the next year one at Heneratgoda yielded nine seeds and in 1882 thirty-six seeds (Trimen in *Kew Bulletin*, 1898, p. 254). At Kwala Kangsar the tree which flowered first, flowered again, but without fruiting; however at its third flowering in 1881 it set fruit, and in doing so was accompanied by another tree which then flowered for the first time (Petch in *Annals of the Royal Botanic Gardens, Peradeniya*, v., 1914, p. 445). In 1882, nine trees flowered and fruited at Heneratgoda. Probably in 1883 † trees first fruited at Singapore; and seed was now sent from the latter place to Sarawak and Kwala Kangsar. But not until 1884 was there any flowering at Peradeniya and Mergui.

---

* Equally early flowering was recorded in the *Agricultural Bulletin of the Straits and F.M.S.*, VI, 1907, p. 176; and yet earlier in the *Report of the Forest Department Ceylon*, for 1894.

† The date of the first fruiting of Hevea in Singapore cannot have been 1881 as stated in the *Agricultural Bulletin of the Straits and F.M.S.*, iv., 1905, p. 365, for Cantley in his *Annual Report on the Botanic Gardens, Singapore*, for the year 1882, p. 12, wrote ' an early crop of seed is looked forward to " as growth had been good in spite of the throw-baek suffered from the poverty of the soil into which they had been transplanted in 1878.

Trimen when he succeeded Thwaites in 1880, found at Heneratgoda "about 300 of the original seedlings" grown to trees, "and at Peradeniya above 20 trees." By cuttings he raised his stock between 1880 and 1894, to 424 at Heneratgoda and 30 in Peradeniya (Trimen, in *Kew Bulletin,* 1898, p. 254).

The Ceylon seed crop, with such a large number of trees, soon reached considerable dimensions, so that it was above 20,000 in 1888; and out of it many places received supplies. The Singapore seed crop was at first used up between the Botanic Gardens, Sarawak, Kwala Kangsar, Kuala Lumpur and Malacca. In the Botanic Gardens, the old indigo ground was chiefly planted up, making a fine heritage to us who come after, and in 1894 some rubber was planted among the trees of the southern corner of the Economic Garden (vide *Agricultural Bulletin of the Straits and F.M.S.*, vii., 1908, p. 253). The smaller Kwala Kangsar crop increased the local plantation and supplied the seedlings which became widely distributed here and there over Perak and on the estates of Mr. T. Hislop Hill § and others in Selangor and Negri Sembilan; and in 1887, they were also the source of a small plantation at Taiping. One of Mr. Hill's estates was Linsum, which again in turn supplied seeds in 1899 to Deli, Sumatra. The Mergui seed crop was used up locally.

The first tapping of Hevea, done in the East, was done by Trimen in October, 1882, and was thus described by him.—"Five of the Hevea trees were prepared by scraping off on one side the rough outer surface of the outer bark; a few short cuts were then made with a knife and the rubber allowed to dry." The first tapping of Hevea by the herring-bone method was done by Dyaks (Wray says Malays) on Sir Hugh Low's request at Kwala Kangsar in the year

---

§ At p. 213 of this Bulletin a very promiment place was given by Mr. Hislop Hill as "the first planter" of rubber in the Peninsula on the authority of Mr. Ridley. Subsequently the following letter from him to Mr. W. Egerton was discovered in the Botanic Gardens, being one of the very few on rubber which have escaped white ants. It is given here to show in what way Mr. Hill was a pioneer.

Bukit Nanas, Sungei Ujong,
1893.

Sir,

I have the honour to acknowledge your letter Misc. 1934/34.

I enclose you a small sample of rubber grown on Linsum Estate from the Hevea brasiliensis and shall be glad to hear what it is worth. The trees are 6 to 8 years old and the yield from one tree is about half a pound and, by the method of collection followed, costs abou 20 cents per pound to collect.

2. I have hundreds if not thousands of trees on my estates; and I shall be glad to supply any quantity of seeds that the Government may wish to buy.

3. The difficulty appears to me to be in collecting the rubber in a sufficiently pure state for the market at a reasonable price.

4. I have found the trees do as well on undulating ground as on the edges of swamps.

I have, etc.,
(Signed) T. H. HILL.

It is believed that the rubber was very inferior and that Mr. Hill got no further at this date than growing scattered trees for seed. But the possession in 1893 of trees 6-8 years old puts him far in front of any other private individual as a cultivator of Hevea.

1888. Collins (*Report on Caoutchouc of Commerce*, London, 1872, p. 36) had described herring-bone tapping as done "in Para, Guiana," etc., by making a vertical cut from high up the tree to the base and numerous short side cuts which were not reopened at all (or at least Collins makes no mention of reopening them). The Dyaks, however, borrowed no ideas from such a source. They tapped the trees rather in the way by which they sometimes draw birdlime or the Samangs draw the juice of the Ipoh tree—*Antiaris toxicaria*, Lesch. (vide *Kew Bulletin*, * 1891, p. 260 and also L. Wray in Ferguson's *All about Rubber*, 1899, p. ccxxxviii). They cut—perhaps one should say hacked—rough herring-bones, but were not exactly successful, it being reported "that scarcely any juice exuded from them." (*Agricultural Bulletin of the Straits and F.M.S.*, ii., 1903, p. 3).

Trimen's 1882 tapping was merely to see if he could get rubber, and in the years immediately following he did not repeat the experiment. But in 1888 he restarted experimental tapping by a modification of the Brazilian method of making numerous small incisions. It is recorded that he tapped but one tree; and that he continued his demonstrations upon it in the years 1890, 1892, and 1894, i.e., in alternate years. These tappings were done timidly for fear of injuring the tree, thus he made cuts in the tree on seventeen days only in the year 1888, seven being near the commencement of the year, in the months of January and February, six at the middle, in in July and August, and four at its close in December. The next tappings were like the first.

In 1889 at Mergui similar rather timid tappings were tried (*Kew Bulletin*, 1898, p. 266).

In 1888 Mr. H. N. Ridley became Director of Gardens, Straits Settlements, and visited the Ceylon establishments on his way to the East (*Agricultural Bulletin of the Straits and F.M.S.*, ix., 1910, p. 202).

When he took over charge in Singapore, there existed in the Economic Garden at least nine trees of the row transferred in 1879, twenty-one trees which had been planted in 1884 and were seedlings from the foregoing, or from Kwala Kangsar thirty trees which had been planted out in 1886, and probably in part came from the Ceylon seed imported in 1885 in a Wardian case, and 1,138 seedlings a year old, and again doubtless from the Gardens' own seed. He at once set to work to care for these, and raised another 8000 plants from a consignment of Ceylon seed.

He tapped to ascertain yield in 1889, (*Agricultural Bulletin of the Straits and F.M.S.*, ix., 1910, p. 202) one year after his arrival, and he reported that the trees "thrive in the damper spots, and those old enough to cut produce a considerable quantity of rubber" (*Annual Report, Botanic Gardens, Singapore*, for 1890, p. 4). Rubber produced from them was exhibited at the Agricultural Show held in 1890 (*Agri-*

* Sir Hugh Low had interested himself in the Ipoh tree in 1881, vide *Kew Bulletin*, 1891, p. 26.

cultural Bulletin of the Straits and F.M.S., ix., 1910, p. 202). To obtain it "the trees were tapped in the herring-bone method," and the latex was collected in cigarette tins and allowed to coagulate naturally "in the tins without the use of acid" (*Agricultural Bulletin of the Straits and F.M.S.*, ix., 1910, p. 202). A pruning knife and a narrow flat chisel seem to have been the implements used in tapping: with the knife the first cut was made, and the repeated shaving was done with the chisel, a wooden mallet being used to drive it forward. One piece of rubber made in these early tappings is preserved in the Botanic Gardens, Singapore, as well as a second of a slightly later date made when saucers were used for coagulation.

Again in the year 1889 an attempt was made to get rubber from the Kwala Kangsar trees, but with no greater success than before, apparently because the herring-bone incision was not wide enough and not reopened, being just an imitation of the method of tapping for Ipoh juice. The great success came in that year—not at Kwala Kangsar, but was Mr. Ridley's. His resort to reopening the wounds was indeed second only in importance as regards the planter to the actual introduction of Hevea into the Old World, and after it the greatest advance that had been made in rubber since the invention of vulcanisation.

As said above, Collins wrote in 1872 of herring-bone tapping extending high up the trees with a large number of side cuts; the plan of Ridley's first tappings seems to have been taken from those tappings, although the vertical channel was generally only two feet long, and to have been variable in extent and in the number of the side cuts; but fearing that the wounds would not heal he ceased the re-opening when the side cuts had a width of half an inch; and the next herring-bone was made in a new place (vide *Agricultural Bulletin of the Malay Peninsula*, No. 7, 1897, p. 136). Considerable experience seems to have been obtained between this commencement and the date (1897) of the Bulletin just quoted, which indicates a not inconsiderable amount of tapping.

This tapping used to be done in the evening, the cups being left on the trees through the night, after the fashion described by Collins on page 8 of his *Report on the Caoutchouc of Commerce.*

In 1895 Dr. J. C. Willis having succeeded Dr. Trimen, the course of the work in Ceylon changed. Dr. Willis tapped again without waiting a year, the tree which Dr. Trimen had been tapping in every other year, and reported that he judged it, at nineteen years, old enough to be tapped annually; he commented by estimating the yield of trees such as it at 100 lbs. per annum from an acre carrying fifty trees. Though bolder tapping was now coming in, the implements were "a ¾ inch chisel, a wooden mallet . . . . and a knife." Dr. Willis' method of tapping was described by him in a *Circular of the Royal Botanic Gardens* (No. 4, 1898, p. 30) thus:—" the tree is first carefully and lightly shaved with the knife from the height of six feet down to the ground; . . . . a clay gutter is next made round the tree about

six inches from the ground, so arranged as to catch the milk; . . . . incisions may now be made in the bark with the mallet and chisel, commencing near the top of the cleared portion. a V-shaped cut is made in two strokes . . . . . a second V-shaped incision should be made about a foot below the first and others at similar distances down to the gutter at the base of the tree. Another set of incisions may then be made parallel to the first at about 10-12 inches from them, and other vertical rows of cuts may be made if there be sufficient room for them." The subsequent tapping was by intercalating fresh V's.

A little later, when Mr. J. Parkin was associated with Dr. Willis, the Ceylon method was subjected to further experiment. The vertical rows of Vs were one foot apart, and the first Vs in the rows also one foot apart. The second incisions were made midway between the first, and thus more or less six inches from them. The third incisions were between the first and the second incisions in every other of the now doubled interspaces, so that the number of cuts was not increased. Thus was the tapping continued (vide Willis, *Circulars 12-14 of the Royal Botanic Gardens, Ceylon,* 1899, p. 133). One tree carried eight rows of these superposed V's; others fewer according to girth. The making of wounds in the form of an X was tried and other variations of the principal scheme; but never was excision or reopening of the wound tried: and the conclusion was reached that "if a double cut be made, the V form is the best (p. 123). A carpenter's chisel and a mallet were used: and to planters it was recommended that the chisel be 1-1½ inches wide, and wedge-shaped.

It is most interesting to observe that the Malayan method had not touched Ceylon yet; and also that either place held to its own course, though soon after this Singapore was advised to abandon the method which Mr. Ridley had so successfully devised. This was in 1898 when Mr. Wickham, returning west from a stay in Polynesia, visited Singapore, and recommended the incision method of tapping of the Amazons, so familiar to him (*Annual Report, Botanic Gardens, Singapore, for 1898,* p. 6); but he did not carry his advice, and there is no record of any use of the method resulting; instead on the other hand not long after the bias towards the herring-bone excision method was asserted afresh (vide *Agricultural Bulletin of the Straits and F.M.S.*, ii., 1903, p. 45). Remarks published on page 332 of the Bulletin of 1902, give one reason why.

In 1896, one tree in the Waterfall Gardens, Penang, came under tapping; and Mr. C. Curtis who tapped it, used a herring-bone with three cuts on each side. There is a plate of this tree in the *Agricultural Bulletin of the Straits and F.M.S.*, for July, 1902, showing it as it was in the year 1902; and, although not very distinct, the reader may, therein observe the nature of the herring-bones used; several can be seen, the last nearly vertically above two others.

The four posts around the tree carried the low platform on which the tapper stood to reach the top parts of the last herring-bone.

Curtis clearly described his method in the *Agricultural Bulletin of the Straits and F.M.S.*, i., 1902, p. 511, thus: "A small perpendicular channel a foot or more in length, and about one eighth of an inch broad, but not deep enough to obtain much rubber is first made, and at the base of this is affixed the tin or other receptable to receive the latex. The channel is not subsequently enlarged: . . . . leading to this channel diagonally are made two or three incisions on either side which supply the latex, and from the upper surface of which a thin shaving is removed every morning, or every alternate morning . . . . . thirteen times which, with the initial opening of the cuts make fourteen operations."

In 1897, Mr. L. Wray tapped at Taiping, (*Malay Mail* of January 19, 1898, quoted in Ferguson's *All about Rubber*, p. ccxxxxiii.) and Mr. R. Derry at Kwala Kangsar, (vide *Perak Museum Notes*, ii., part 2, p. 101, as well as the last reference), both using the herring-bone. Later tappings by Mr. Derry at Kwala Kangsar are recorded in the *Agricultural Bulletin of the Straits and F.M.S.*, i., 1901, p. 20.

Curtis' plate referred to, and the expressed statements of Messrs. Wray and Derry show that the side cuts were opposite, and Mr. Wray remarked that in healing this proved disadvantageous, (*Perak Museum Notes*, ii, 1897, p. 96, reprinted in Ferguson's *All about Rubber*, 1899, p. c), for the covering up of the wound was slow at the points where two side cuts made with the vertical channel an unusually wide wound. He suggested with a diagram that the side cuts should alternate.

Experimental tapping, commenced in 1900 at Tjikeumeuh in Java, by Dr. Tromp de Haas, was by excising the lower edges of oblique cuts in series by a chisel on nine successive days (vide *Agricultural Bulletin of the Straits and F.M.S.*, iv., 1905, p. 286).

Tapping in Singapore was done over all the years about this time for various purposes, often for the instruction of a visitor and to demonstrate rubber: these tappings went unrecorded; but one is mentioned in the *Annual Report of the Botanic Gardens*, for the year 1900, page 7, wherein an attempt was made on a single tree five feet five inches in girth, to ascertain how long it required to tap it dry, and its wounds were reopened on eighty-four successive days until this happened. It is a pity that the subsequent history of the tree is unknown.

It is evident that other trees received a much lighter treatment.

Right from 1889 tapping seems to have been done irregularly; and the number of trees used for it apparently exceeded 150 by little, of which number 134 were standing in 1904.

In 1901 Mr. Ridley went on long leave; and with this what may be regarded as the first period of experimental tapping in the Botanic Gardens, Singapore, came to an end.

In the same year Mr. Stanley Arden came out from Kew to take charge of the Perak rubber plantations, etc. In his experiments at Sitiawan, in Perak (1901-02), the form of the wound varied greatly, but it was always excised (*Report on Hevea brasiliensis,* Taiping, 1902). He used at first a carpenter's chisel and a wooden mallet, but entirely discarded these later in favour of a very sharp pruning knife. He experimented with straight cuts at an angle of 30° six inches apart, six inches long in a vertical series of twelve (to find out which part of the trunk should be tapped) reopened ten times, five each day over twenty-four days; and (2) V-cuts in series of five or of twelve, each limb six inches long and the angle as before, reopened five times or ten times over twenty-four days or twelve times over twenty-four days; and (3) herring-bone cuts at different heights, each vertical channel 2½ feet long draining six side channels in all, each one foot long, reopened on fourteen consecutive days; or (4) herring-bone cuts one foot long with three feeders two on one side and the third on the other, eight inches long and one foot apart, reopened on eight consecutive days.

The conclusion was reached that cuts or small herring-bone cuts on the lower part of the trunk not above six feet appear desirable (p. 11).

Mr. Derry at Kwala Kangsar in this year was using herring-bones with the "centre channel about four feet" long having "five oblique cuts on each side"; three herring-bones were made on each tree (Annual Report quoted in *Agricultural Bulletin of the Straits and F.M.S.*, i., 1902, p. 327).

When Mr. Ridley returned from leave in 1902, it appears that more regular tappings were instituted in the Botanic Gardens; and when on July 1st., Mr. A.D. Machado joined the department, the latter took charge of the work. Herring-bone incisions were used (vide *Agricultural Bulletin of the Straits and F.M.S.*, ii., 1903, p. 45): and in one or two they were carried up to an unusual height as is seen in the plate included in this number. The plate in question well shows how the side cuts were opposed in spite of Mr. Wray's excellent advice.

In February 1903, a Monsieur Bonnechaux, who had lived among the seringueiros of the Amazons, visited the Gardens, and advised against the excision method in use, saying that it would kill trees in the Amazon region very rapidly; and he recommended the incision method that he had used himself in Brazil. So far he carried his point that under his direction 150 trees were tapped (vide *Agricultural Bulletin of the Straits and F.M.S.*, ii., 1903, p. 45). Some of these trees were virgin, but many had been tapped before.

Scars of a Herring-bone tapping which was carried to an unusual height.

Economic Gardens, Singapore.

It is interesting that M. Bonnechaux only a few months after Mr. Arden had remarked on "the rapidity with which the wounds heal" *(Report on Hevea brasiliensis*, p. 13), should have insisted so strongly that the trees tapped by herring-bones "would in the Amazons be speedily destroyed by insects attacking the exposed wood" (l. c., p. 45) and obviously M. Bonnechaux's knowledge of Malayan conditions was slight. Nevertheless Mr. Arden had feared to reopen the cuts that were becoming wide, and had desisted from tapping in every case beyond the fourteenth time. But on the whole the remarks of both men really point us to the amount of damage that was done by the tapping implements used. *

After M. Bonnechaux's few days stay were over, Mr. Machado continued to tap as started by him, but using only 100 trees. He tapped from March 4th. to May 27th. *(Agricultural Bulletin of the Straits and F.M.S.*, ii., p. 47, 112, and 264). He made one cut only with the axe on each of the first five days, and then two cuts to each tree on each of the next four days, and then ten cuts four times on twenty trees or five cuts once on forty trees but thereafter four cuts for the most part on every other day up to twenty three repetitions.

These 100 trees so treated were certainly chosen from among the 150 tapped by M. Bonnechaux; and it is recorded that they all stood in the triangle of the plantation near to the entrance gate (l.c., p. 46), which we now call Block 1.

Tapping at this date was done no longer in the evening, but in the morning.

"Conjointly ten large trees growing under more favourable circumstances than the hundred were tapped eighteen times in seventy-five days" *(Agricultural Bulletin of the Straits and F.M.S.*, ii., 1905, p. 113, vide also p. 266) by M. Bonnechaux's method. These trees can only be those standing in a row which were the oldest that the Gardens possessed. It is recorded along with this information that in previous years they had been very heavily tapped by the herring-bone method (p. 112). "Very heavily" in this case would mean that they were abundantly scarred by reason of the repetition of tapping in different parts of the trunk, not that they had been submitted to any continued tapping.

Mr. Machado now set aside another 100 trees, and tapped them by M. Bonnechaux's method twenty-three times in thirty-three days, commencing on May 29th., (l.c. p. 265). One cut was made on the first day and on the four following days; two cuts were made on the next four days, then four, and after that more up to ten cuts. The reader by turning to the plate issued with the *Agricultural Bulletin of the Straits and F.M.S.*, for November, 1903, may note

* Many were fully aware of this. Mr. Ridley in 1897 (*Agricultural Bulletin of the Malay Peninsula*, No. 7, p. 136) and the writer of the article "rubber" in *Spon's Encyclopaedia* had alike suggested a guard on the knife put into a coolie's hand for tapping.

the ten cups on a tree. Mr. Machado also tapped a further lot of ten trees six times commencing May 29th. (l.c., p. 266) by M. Bonnechaux's method. In the *Straits Times* of April 16th, 1903, the cuts are said to have been 1½ inches long by ⅛ inch wide, and in the *Straits Echo*, (reproduced in the *Tropical Agriculturist* of September 1st, 1903, p. 154) it is said that the cuts made were two inches long.

Next, commencing on July 8th. 5 large trees were tapped fifteen times in nineteen days by herring-bones, a semicircular chisel being used for the reopening of the wounds. The reader will note the change in the shape of the chisel used: and it is interesting to record that on the Bukit Lintang Estate in Malacca, tapping in 1904 was done by means of a similar implement (vide *Tropical Agriculturist* for October 1st., 1904, p. 240).

At the end of July, 1903, Mr. Machado left, and Mr. C. Boden Kloss came. Tapping was continued and Mr. Kloss informs the writer that he corroborated Mr. Machado's results.

With Mr. Kloss' departure ended the second period* of tapping in the Singapore gardens.

During this short period it was realised that the trees are resistant enough for tapping much more prolonged than anything done previously, if only the tapping be wisely done. Machado had bled trees on every other day for six months (vide *Straits Times* of April 16, 1903, reprinted in the *Tropical Agriculturist* of June 1st, 1913, p. 839); and it was written "From 100 trees averaging from 12 to 15 years of age, and planted much too closely to admit of their being properly developed, Mr. Machado drew on an average about three pounds of dried rubber daily and he expects the supply to be maintained for six months working half the trees each day during that period. Then these trees will be given a rest of six months." Much in contrast with Machado's results is a statement made in *Teysmannia*, 1903, No. 8, to the effect that it had been possible at Soebang in Java to reopen half herring-bone cuts on alternate days only ten times and at Buitenzorg only fifteen times.

Four government trees in Malacca, fourteen years old, were tapped by herring-bones in 1903 by Mr. Gagliardi on eight days, and then by two herring-bones on fourteen days (*Agricultural Bulletin of the Straits and F.M.S.*, ii., 1903, p. 191).

With the coming of Mr. R. Derry to Singapore in the commencement of 1904 fuller records of tapping in the Botanic Gardens

---

* In summary it may be stated that to this date the Garden's trees had been tapped thus :—

Tappings by Mr. Ridley,—number of trees unrecorded 1889-1903.
Tappings by Mr. Bonnechaux—150 trees for a few days.
Tappings by Mr. Machado—215 trees, 100 having been virgin.
Tappings by Mr. Boden Kloss,—a continuation of the last.

Greatest number of trees tapped as indicated by these records 250, being 150 by M. Bonnechaux and 100 virgin trees by Mr. Machado. How many over and above this figure had been tapped it is impossible to state, but it is believed that the number was small.

commenced. In the first place all the standing trees—1285—were numbered serially, and a record of their condition compiled. From this record we learn that the standing trees which had been tapped were 234; therefore at least sixteen had died in the last year. And from the same useful record we learn which trees were of 1877 and some of other years.

Under Mr. Ridley, Mr. Derry now set out "to experiment on the . . . . trees planted in 1886, 1887 and 1888" (*Agricultural Bulletin of the Straits and F.M.S.*, iii., 1904, p. 332), having before him a series of objects, one being for instance to ascertain in what part of the day tapping should be performed; another to demonstrate how incision after the Brasilian method is inferior to excision; a third to enquire into the relative value of distributing lines of excised cuts over the bark against making a single excised line, and so on. With the results on latex, we are not here so much concerned as with the amount of cutting that the experiments involved and the way in which it was done. By the end of 1904 Mr. Derry had tapped 850 trees.

Four reports were published on the experiments of the year. The first was over Mr. Derry's name and appeared in the September number of the *Agricultural Bulletin of the Straits and F.M.S.*, where despite the month given on the cover of the part, it carried the record of tapping into October; the second appeared as a continuation of the first in the November number of the Bulletin and prolonged the record to the middle of that month, and the third in the April and May, 1905, numbers; the fourth under the joint names of Messrs. Ridley and Derry was a Report to Government, dated 7th. November, 1905, which was printed separately and also in the *Agricultural Bulletin of the Straits and F.M.S.*, for November, 1905, vol. iv., 1905, p. 424. From the prefatory remarks to the last cited it is learned that tapping was done in March, April, May and June, but that this was not altogether satisfactory, so the recorded experiments actually were dated from July 4th.

Experiment I of 1904, had for its first object the ascertaining of the time of day—morning or evening—at which trees should be tapped; and it had as a second object the comparison of M. Bonnechaux's Brasilian method with excision along oblique cuts. Instead of the small axe after the Brasilian model which had been made for M. Bonnechaux, a half-inch carpenter's chisel was used; the cuts were distributed all over the lower part of the trunk of the trees set aside for the purposes. Ten cuts were made per diem. The same implement was used for making the oblique cuts on the trees of the contrasting part of the experiment. The tapping of these trees was by superposed converging or diverging cuts—the cuts in two series not near enough to make Vs or inverted Vs; in some of the trees the cuts converged downwards and in others diverged downwards. In a comment Mr. Derry described the design as "a herring-bone without a central channel;" but the description is

hardly good, regardless of its paradox, for the two series seem to have been separated by at least four inches of uncut bark. The lower edge of the cuts was excised at each tapping. Two excellent illustrations of this method of tapping were given on page 168 of the *India Rubber Journal*, for July 31st, 1905, the trees being No. 196 and another now dead; further, tree 152, similarly tapped, can be seen in one of the illustrations on page 166.

Experiment 2 also compared morning with evening tapping; and it compared Bonnechaux's Brasilian method, subject to the change above noted in the tool used, with tapping by ten long oblique cuts reopened at different intervals of time, and with herring-bone tapping.

Mr. H. Overbeck has very kindly put at the writer's disposal a photograph of tree No. 174 which shows the scars of the tapping after Bonnechaux, done on that tree in 1904. Tree 356, treated in the same way, was figured in the plates attached to the November, 1905, issue of the *Agricultural Bulletin of the Straits and F.M.S*, and tree 148 was excellently figured in the *India Rubber Journal*, for July 31st, 1905, page 166, as well as others now dead on page 169. Mr. Overbeck's photograph is here reproduced on plate 2 (p. 249). Ten of the little cuts seen in it were made daily in the experiment. The first contrast to it was of tappings by converging cuts superposed in a series—just as described under experiment I; and the second contrast to it was of herring-bone tapping. The herring-bone tapping of this year has been well illustrated. A plate showing a herring-bone scar of 1904 on tree No. 2 was given with the issue of the *Agricultural Bulletin of the Straits and F.M.S.*, for July, 1908: another plate of tree No. 2, is issued with this number which also shows a herring-bone scar of the same year. The plate issued with the number for June, 1905 of a tree now dead shows the scar of 1904 which has ten side cuts, as well as the ends of an earlier scar which has but eight. This tree was one of a row figured on page 167 of the *India Rubber Journal*, of July 31st, 1905, more of which are there seen to have been tapped in the same way in 1904. A plate prepared long ago, but only now issued with this number shows a scar of the year on the tree No. 7 with five cuts on one side and six on the other. It is on the whole evident that herring-bone tappings of this year had generally five cuts on each side. It also evident that in making the converging cuts of the contrast, there were five pairs of converging (or diverging) cuts, so to give approximately the same amount of cut surface in each case. But of course in the imitation brasilian tapping the cuts being short, very much fewer laticiferous vessels would be made to bleed than in the two contrasts; and naturally the method produced much less rubber; the experiment thus was a not quite fair one; but with the results in rubber we are here little concerned. In connection with the cutting resulting, the reader's attention is specially directed to the last quoted plate; for in it the pruning knife, used in making the first cuts and sometimes afterwards, is distinctly seen.

7

Experiment 3 may be called a variant of experiment 2; but 5 cuts only were made daily in those trees given over to the modifcation of M. Bonnechaux's method. Tree 342 which was one of the trees tapped by five cuts daily, can be seen in illustration 6 on page 163 of the *India Rubber Journal*, July 31st, 1905.

Experiment 4 while repeating the morning-versus-evening experiments, contrasted the results of daily and alternate day tapping by the use of the herring-bone method.

Experiments 5 and 6 were an elaboration of experiment 2.

The year's results were held to condemn afresh, the brasilian method of M. Bonnechaux, although, as said, from the point of yield it had a hardly fair trial; they indicated morning tapping as the right thing, and they suggested that alternate day tapping by herring-bones would yield more than daily tapping per unit of labour. Incidentally the inconvenience of multiplying the number of cups on the trees became evident, although the ten long cuts converging in pairs did yield at a high rate.

In no single case were the cuts reopened more than twenty-eight times; for it was feared that the tree might thereby be killed. It had become more clearly recognised that the tapping implements used were ill-suited to the purpose; and in the end of the first of the reports Mr. Derry pointed out that the danger lay in the depth of the incision and not in the quantity of surface removed; he added that the half inch carpenter's chisel "is not an instrument that can be commended, as apart from the possibility of punching too deeply, there is also the danger of raising the bark." It has been mentioned above that Mr. Arden discarded it.

The carpenter's gouge which at this time was being used on the Bukit Lintang Estate, was there too recognised as liable to cause injury and the tapping was limited to two short periods per annum of only fifteen days—fourteen reopenings.

The year 1905 was hardly an experimental-tapping year as regards the trees in the Botanic Gardens, Singapore, used in 1904; for though the trees were tapped, they were treated in a tapping rotation; and they were all cut in herring-bones, but with varying periods of reopening. A report appeared in the *Agricultural Bulletin of the Straits and F.M.S.*, v., 1906, p. 439.

The trees which had made experiment I, in 1904, were all tapped alike, and twice within the twelve months—just a little more boldly than were the trees of the Bukit Lintang Estate, for there were twenty-four and twenty-one reopenings of the wound at the respective periods. The trees of experiments 3, 4, 5 and 6, at a different time for each group, were tapped alike. But as there had been a considerable number of deaths among the trees either by wind or by *Fomes* or by other causes, new trees were put into the tapping rounds to

make up the numbers. The trees which had made experiment 2 in 1904 only, were not all treated alike,—this not by varying the tapping but by deferring it in the case of a part of the trees so that the resting intervals became unlike.

There was, however, an experiment in tapping, which was called 7, but which will be called Experiment U here to distinguish it from a later experiment 7. Experiment U was an attempt to estimate the relative values of daily and alternate day tapping, and is to be regarded as the conclusion of the experimental work of 1904.

But besides the working of these trees by Mr. Derry into a tapping rotation, there was other tapping done in the Plantation in the early part of the year. In the first place Mr. Ridley tapped about 24 trees for various purposes; and in the the second place, Mr. Burgess, then Government Analyst in Singapore was allowed the free use of a considerable number of trees, whence he drew latex for experimental work in factory processes. There is no record of the way in which these trees were tapped, but reason to believe that new tapping tools were used and designs of cuts were tried.

Tapping knives were not used as far as is known, in Mr. Derry's tappings of the year; but the tapping was done as before with the pruning knife and chisel. The Ceylon Gardens at the time were using tapping-knives, for Mr. Herbert Wright who was then in charge of rubber work at Heneratgoda, which he had systematised in October, 1904 (*Tropical Agriculturist*, xxv., 1906, p. 309), was employing the Northway-Bowman knives in his tapping. And already on the Culloden Estate on seven trees from 1891 "every known method of tapping" had been tried (*Tropical Agriculturist*, May 2, 1904, p. 764). The first record of the use of tapping knives in the Singapore Botanic Gardens in Mr. Derry's experiments was early in 1906, when several sets of this particular knife (the set is of three knives) were procured from Ceylon, and tried, but it is believed without finding favour; and when a little later a tapping knife, was definitely adopted in the Singapore Gardens, after various trials, it was of the farrier's knife pattern as described in the following statement * by Messrs. Ridley and Derry, (*Agricultural Bulletin of the Straits and F.M.S.*, v., 1906, p. 460)." The implement capable of making the cleanest and quickest incision is the ideal one. This we have found in an English . . . . modified farrier's blade adjusted by a screw in a sliding socket . . . . Nearly all invented knives or tools have been experimented with at the Botanic Gardens; some have been found unhandy, others unsuited for coolie use, and some much too fragile."

The application of the farrier's knife to rubber has a long record. As for back as 1872, Collins had described and figured a form of it

* The statement occurs in the report on the Tapping experiments of 1905, but was written towards the end of 1906.

Photo by] [*H. Overbeck, Esq.*

Photo by] [*H. Overbeck, Esq.*

Spiral tappings of trees Nos. 2130 (on the left) and 2. The scars of an older herring-bone tapping may be seen on tree No. 2.

used for marking timber in Germany, suggesting that it should be tried for tapping rubber trees. His suggestion however did not bear fruit and was forgotten as planters had no need of tapping knives. History repeated itself and the same idea came forward again when Wray to help on his experiment at Taiping made what was but a small modification of the same knife. Later, it seems quite independently, Mr. F. A. Stephens, then manager of the Jebong Estate in Perak, reproduced the device. Though we call it the Jebong knife now, the principle and its application to rubber are much older than rubber on the Jebong Estate. Its simplicity is the chief cause why it has found favour in the Malay Peninsula: whereas ingenious patents have generally been the produce of Ceylon.

In 1906, experimenting was renewed in the Botanic Gardens, at Singapore, the trees which had served for experiments 4 and 5 in 1904 being used, while those which had made the other experiments were tapped in rotation as in 1905. To all groups additional trees were added where death had made gaps. These additional trees were a very mixed lot: some had been tapped before 1904; some had been tapped by Mr. Ridley in 1905; some had been tapped by Mr. Burgess in 1905; some had been part of experiment U; and some were virgin. Added to the experiments now was an experiment 7 a comparison of herring-bone tapping with spiral tapping and at the same time a trial of the pricker. Spiral tapping was also done on other trees in two forms, one a genuine spiral or "full spiral," the other intermediate between spiral and long oblique tapping or "half spiral." These two forms of tapping, both of which in the Gardens' records and in Ceylon were alike called "spiral," are illustrated in plate 5 herewith published. The reader with that before him will for himself realise how very much more the descending sap current is interfered with in the one than in the other. Tree No. 2 which is that in the right hand figure had seven five and a half feet long cuts made in it: these are shown and also there may be seen herring bone cuts of 1905 and 1906 made when the tree was in experiment U or in experiment 6. The same tree was figured in an earlier stage in the plate published with the July 1908 number of the *Agricultural Bulletin of the Straits and F. M. S.* The tree again makes plate 4 of this issue, as it was at its death in 1914, which may be compared with the tree figured in the *Tropical Agriculturist,* xxv., 1906, opposite p. 724: and the plate of the full spiral may be compared with that opposite p. 644.

In 1907, Mr. Ridley took leave on April 22nd, Mr. Fox replacing him, and Mr. Derry proceeding to Penang. Mr. Fox thus took charge of the rubber work, being aided from August to November inclusive, by Mr. C. Boden Kloss who returned to the Gardens for this short time. Mr. Fox maintained the tapping: and the records which he kept are a monument to his diligence. One new experiment was instituted by Mr. Boden Kloss, a comparison of single and twin basal cuts. This experiment was described in the *Singapore Free Press* of

November 7th, 1907, under the title of "Base tapping for rubber trees." The basal tappings were contrasted with herring bone tappings. In the Gardens' records this experiment was called 8 but because there was framed later by Mr. Derry another experiment 8, the basal tappings will be called here V and W according to their degree, V for the single and W for the twinned basal cuts. Other trees which had been experimented with earlier were tapped in their groups, not exactly experimentally, but in a tapping rotation, in connection with which Mr. Fox started and Mr. Boden Kloss kept up a most extensive series of daily observations on the amount of latex which they yielded.

For some reason these valuable and extensive records were kept on separate sheets instead of in the usual books, or they were written up in books which became separated from the proper records, and it was only after weeks of search that the writer found among waste paper all those now recovered. It may be that some are lost, and if so this is a great pity, for the individual tree record is just what is wanted for the work now in hand.

Mr. Ridley returned early in 1908; and to the existing staff was added in April, Mr. T. W. Main, Mr. Derry being now on leave. Mr. Main took charge of the rubber-work together with other duties, which seem to have had preference so that the tapping recorded as having been done in 1908, is very meagre. Mr. Main informs the writer that one record which he kept, was destroyed by white ants. There is an incomplete record of an experiment done in the year on the trees which had served for the experiment 2 of 1904, in which half were tapped by a herring bone and half by basalV: but unfortunately it is unrecorded which trees were treated in the one way and which in the other.

Mr. Derry resumed charge of the tapping work in 1909.

First of all in that year, perhaps by mistake, a few trees, from among those which had made experiment 1 of 1904, were tapped twenty-seven times in thirty-one days. This tapping is here called Z. It did not extend to more than a small portion of the trees of either of the halves into which experiment 1 had been divided: but took some virgin trees.

After this, shortage by reason of deaths was made good by adding new trees to the groups: many of those added were from among trees tapped by Mr. Ridley and Mr. Burgess in 1905.

This done, tapping was recommenced on the old rotation, and into it two new groups of trees called 9 and 10 were introduced.

One real experiment, and one only, was done in this year, a comparison on the "chain gamma" method of making a herring bone which Mr. Boden Kloss had invented, with the ordinary herring bone.

This "chain gamma" was illustrated in the *Agricultural Bulletin of the Straits and F.M.S.*, vi., 1907, p. 389. In it the side cuts as of the herring bone alternate and each is prolonged downwards until it meets the next cut of the other side, its lower part thus serving as the conducting channel, the course of the latex flowing down to the cup being thus along a zig-zag which has feeders at each of its elbows.

"A third report on the experimental tapping of para rubber" was issued by Messrs. Ridley and Derry in the year, wherein (p. 2) it was observed that "tapping on alternate days showed an advantage over tapping daily" and which advocated tapping by a half herring bones following basal tappings. The report further contains much outside the subject of the treatment of the trees.

Although tapping knives had now been adopted in the Gardens and the damage to the trees had become very much less, the tapping periods were still kept short under the argument that the "crop of seeds was . . . . of the first importance . . . . and heavy tapping" might be "detrimental to seed production" and ought to be avoided. Therefore to carry through 30 successive tappings—sometimes a few more and sometimes a few less—was the course pursued; and after the tappings a prolonged rest was given.

In 1910 the last real tapping experiment was done on the Singapore trees. It was a comparison of the full herring bone with the half herring bone, and was done on the trees which had served for experiment 7 in 1906 and 1907. Whether it influenced planting opinion or not, it coincided with a breaking away from the old practice of many cuts.

In this year all the other tapped trees were tapped in a rotation, some of course at a season favourable for a large flow of latex, others at an unfavourable season. Comparisons of yield under such circumstances are not worth much and do not concern us: what does is that the trees were not being *tapped* in tapping experiments.

From the year 1911 to the end of the first quarter of the year 1914 the tapping rotation has been continued. In 1914 it was abandoned as it entailed unproductive work.

Mr. Derry's attention was meanwhile diverted to coagulating experiments, and in 1912 the retirement of Mr. Ridley gave him wider administrative duties, in consequence of which subordinates were left to carry out the tapping and to enter the results. The records of the years 1911 and 1912, have many mistakes in them. These mistakes the writer considers as cases of the copying of wrong numbers and not of the tapping of wrong trees, for it ought not to have been possible by carelessnees for these men to tap wrong

trees seeing how thoroughly Mr. Derry has numbered them: rather, a fault lay in neglecting to verify the written record after it had been made; and it is fortunate that it is no more, for had wrong trees been tapped the result would have been to render of little value the present attempt at constructing the past tapping-history of each tree. Instead the writer believes that he has been furnished with a fairly accurate record of how each of his possible seed-parents has been bled in the past. To have this knowledge is especially important if it be true that tapping interferes with the germinative power and perhaps other functions of the seed. In any case the knowledge of what has happened to the trees is a desirable adjunct to the work now in hand.

The following tables bring into one view the tappings as far as known. There are in all 156 variations, which can be briefly expressed by symbols. The serial tappings under Mr. Derry, Mr. Boden Kloss, Mr. Fox and Mr. Main are denoted in them by consonants thus:—

B. Denotes experiment 1 of 1904 and the rotation tappings which followed it.

C. Denotes experiment 2 of 1904 and the rotation tappings which followed it and also the incompletely recorded experiment 2 of 1908.

D. Denotes experiment 3 of 1904 and the rotation tappings which followed it

F. Denotes experiment 4 of 1904, the rotation tapping which followed in 1905, the experiment 4 of 1906, and the subsequent rotation tappings.

G. Denotes experiment 5 of 1904, the rotation tapping which followed in 1905, the experiment 5 of 1906 and the subsequent rotation tappings.

J. Denotes the experiment 6 of 1904; and the rotation tappings which followed in all subsequent years.

K. Denotes the experiment 7 of 1906 and of 1907 and 1910 with the subsequent rotation tappings.

M. Denotes the experiment 8 of 1909 and the subsequent rotation tappings.

N. Denotes the rotation tappings which were called "experiment 9" from the year 1909.

P. Denotes the rotation tappings which were called "experiment 10" from the year 1910.

R. Indicates the tapping of tree No. 2 which was intermediate between spiral and long oblique, practised on it in the years 1906, 1909, 1912 and 1913.

S. Indicates the true spiral tapping done on several trees in 1906.

Numerals after these letters denote the modifications of the experimental tapping to which the trees were submitted.

Vowels are used to denote the odd tappings which were done from time to time irrespective of any rotation, thus :—

A. Denotes tappings done before 1904.

E. Denotes tappings done by Mr. Ridley in 1905.

O. Denotes tappings done by Mr. Burgess in 1905.

U. Denotes an (apparently mistaken) tapping done in 1905 on twenty trees.

V. Denotes a single basal line cut in 1907.

W. Denotes a pair of these cuts at the same time.

Z. Denotes a mistaken tapping of a few trees done in 1909.

Q. Denotes the tapping of trees in block 2 in 1913.

In cases where a tree was not subjected to one of the rotation treatments from the very beginning, a small letter instead of a capital letter is used to denote its treatment, thus "b from 1906" means that the tree received treatment B from the year 1906: then "Ab from 1906" means that it was tapped before 1904 (A) and that it was put into rotation B in 1906 to make up the number of trees: OWMI, means that the tree was tapped by Mr. Burgess in 1905 (O), by two basal cuts by Mr. Boden Kloss in 1907 (W), and was put into "experiment 8" (M) by Mr. Derry in 1909 being one of the trees tapped by a half herring-bone (M1).

The total number of tappings under the different treatments comes out at a small number with regard to the days which elapsed between July 4th, 1904 and March 14th, 1914, when the old order of tapping was abandoned, *i. e.*, 3650; that is to say it was light treatment an regards removal of latex, but up to 1906 it was associated with considerable damage to the cambium in consequence of the nature of the tools used in tapping. All trees with the vowel A, E and O in their symbol are likely to have suffered from other injurious cutting. But such cutting is not associated with the later consonants of the alphabet M, N, P, Q, R, S and Z. But it is associated for two years with the earlier letters B, C, D, F, G, J, K and L.

TABLE

Understand "Days" after

Symbol.	Tapped before 1904.	Tapped in 1904.	1905.	1906.	1907.	1908.
ABI	Yes	Ten oblique cuts superposed in 2 series 15 in 18 with 394 rest	Complete HB. 25 in 25 with 73 rest: 22 in 22 with 174 rest	Complete HB. 25 in 26 with 366 rest	Complete HB. 31 in 44 with 594 rest	...
AZBI	do.	do.	do.	do.	Tapping same, but with 504 rest	...
BI	...	do.	do.	do.	as ABI	...
AB2	Yes	Ten Scattered not-reopened cuts, 15 in 18 with 394 rest	do.	do.	do.	...
AZB2	do.	do.	do.	do.	as AZBI	...
B2	...	do.	do.	do.	do.	...
Eb	...	...	Burgess	...	...	...
Ub.	...	...	Complete HB. 17 in 37 with 271 rest: 22 in 22 with 174 rest	as ABI	as ABI	as ABI
A f3b	Yes	as F3	as ABI	do.	do.	do.
ACI	Yes	10 Rather Long oblique cuts 16 in 52 with 354 rest	Complete HB. 21 in 41 with 43 rest: 24 in 25 with 279 rest	Complete HB. 25 in 51 with 278 rest	Complete HB. 28 in 82 with 205 rest	Either complete HB. or basal V. 34 in 65 with 229 rest
CI	...	do.	do.	do.	do.	do.

I.

each Numeral.

1909.	1910.	1911.	1912.	1913.	1914
Complete HB 30 in 35 with 150 rest: 30 in 34 with 89 rest	Complete HB. 32 in 33 with 82 rest: 31 in 31 with 75 rest: 29 in 34 with 118 rest	~~Half HB.~~ 30 in 33 with 141 rest: 30 in 34 with 36 rest	Half HB. 59 in 66 with 152 rest: 30 in 33 with 138 rest	Half HB. 31 in 35 with 154 rest: 31 in 31 with 71 rest: 31 in 34	...
Complete HB. 27 in 31 with 59 rest: 30 in 35 with 150 rest: 30 in 34 with 89 rest	do.	do.	do.	do.	...
as ABI	do.	do.	do.	do.	...
do.	do.	do.	do.	do.	...
as AZBI	do.	do.	do.	do.	...
do.	do.	do.	do.	do.	...
do.	do.	do.	do.	do.	...
do.	do.	do.	do.	do.	...
do.	do.	do.	do.	do.	...
Complete HB. 30 in 64 with 122 rest: 24 in 27 with 91 rest	Half HB. 33 in 36 with 106 rest: 31 in 32 with 170 rest	Half HB. 30 in 30 with 121 rest: 30 in 32 with 150 rest	Half HB. 59 in 66 with 112 rest: 30 in 33 with 138 rest	Half HB. 31 in 35 with 156 rest: 31 in 31	...
do.	do.	do.	do.	do.	...

TABLE

Understand "Days" after

Symbol.	Tapped before 1904.	Tapped in 1904.	1905.	1906.	1907.	1908.
AC2	Yes	10 Long oblique, cuts 18 in 21 or 22 with 384 or 385 rest	Complete HB. 21 in 41 with 43 rest: 24 in 25 with 279 rest	Complete HB. 25 in 51 with 278 rest	Complete HB. 28 in 82 with 205 rest	Either complete HB. or basal V. 34 in 65 with 229 rest
C2	...	do.	do.	do.	do.	do.
AC3	Yes	Complete HB. 18 in 22 with 384 rest	Complete HB. 21 in 41 with 72 rest: 25 in 27 with 250 rest	do.	do.	do.
C3	...	do.	do.	do.	do.	do.
AC4	Yes	Five Scattered not-reopened cuts, 14 in 17 with 389 rest	as AC1	do.	do.	do.
C4	...	do.	do.	do.	do.	do.
Ec1	...	...	Director: Complete HB. 21 in 41 with 43 rest: 24 in 25 with 279 rest	do.	do.	do.
Ec3	...	...	Director: Complete HB. 21 in 41 with 72 rest: 25 in 27 with 250 rest	do.	do.	do.
Oc	...	...	Burgess	...	...	...
Uc	...	...	Complete HB. 17 in 37 with 1541 rest	...	...	...
AD1	Yes	Long oblique, 15 in 33 or 34 with 347 or 348 rest	Complete HB. 18 in 35 with 61 rest: 25 in 25 with 260 rest	Complete HB. 25 in 51 with 280 rest	Complete HB. 28 in 68 with 215 rest	Complete HB. or Basal V. 27 in 64 with 234 rest
D1	...	do.	do.	do.	do.	do.

I.—*Continued.*

each Numeral.

1909.	1910.	1911.	1912.	1913.	1914.
Completc HB. 30 in 64 with 122 rest: 24 in 27 with 91 rest	Half HB. 33 in 36 with 106 rest: 31 in 32 with 170 rest	Half HB. 30 in 30 with 121 rest: 30 in 32 with 150 rest	Half HB. 59 in 66 with 112 rest: 30 in 33 with 138 rest	Half HB. 31 in 35 with 156 rest: 31 in 31	...
do.	do.	do.	do.	do.	...
do.	do.	do.	do.	do.	...
do.	do.	do.	do.	do.	...
do.	do.	do.	do.	do.	...
do.	do.	do.	do.	do.	...
do.	do.	do.	do.	do.	...
do.	do.	do.	do.	do.	...
...	do.	do.	do.	do.	...
...	do.	do.	do.	do.	...
Complete HB. 30 in 60 with 257 rest: 28 in 33 with 273 rest	Complete HB. 30 in 32 with 155 rest	Half HB. 30 in 34 with 131 rest: 25 in 28 with 75 rest	Half HB. 59 in 66 with 112 rest: 30 in 33 with 138 rest	Half HB. 31 in 35 with 156 rest: 31 in 31	...
do.	do.	do.	do.	do.	...

TABLE

Understand "Days" after

Symbol.	Before 1904.	1904.	1905.	1906.	1907.	1908.
AD2	Yes	Complete HB. 18 in 20 or 21 with 360 or 361 rest	Complete HB. 18 in 35 with 61 rest: 25 in 15 with 260 rest	Complete HB. 25 in 51 with 280 rest	Complete HB. 28 in 68 with 215	Complete HB. or Basal V. 27 in 64 with 324 rest
D2	...	do.	do.	do.	do.	do.
AD3	Yes	Scattered not-reopened cuts, 23 in 26 with 355 rest	do.	do.	do.	do.
D3	...	do.	do.	do.	do.	do.
AD4	Yes	Complete HB. 15 in 32 with 348 rest	do.	do.	do.	do.
D4	...	do.	do.	do.	do.	do.
Ed.	...	...	Director: complete HB. 18 in 35 with 61 rest; 25 in 25 with 260 rest	do.	do.	do.
AOd.	Yes	...	Burgess	...	..	...
Od.	...	...	Burgess: Complete HB. 25 in 25 with 260 rest	as above	as above	as above
Ud.	...	...	Complete HB. 17 in 37 with 1545 rest	...	...	...
ACId.	Yes	as CI	...	as D	as D	as D
AFI	Yes	Complete H.B 18 in 21 with 358 rest	Complete HB. 25 in 25 with 117 rest	Complete HB. 25 in 25 with 251 rest; 25 in 27 with 310 rest	Complete HB. 41 in 60 with 222 rest	Complete HB. 31 in 38 with 331 rest
FI	...	do.	do.	do.	do.	do.

I.—*Continued.*

each Numeral.

1909.	1910.	1911.	1912.	1913.	1914.
Complete HB. 30 in 60 with 257 rest; 28 in 33 with 273 rest	Complete HB. 30 in 32 with 155 rest	Half HB. 30 in 34 with 131 rest; 25 in 28 with 75 rest	Half HB. 59 in 66 with 112 rest; 30 in 33 with 138 rest	Half HB. 31 in 35 with 156 rest; 31 in 31	...
do.	do.	do.	do.	do.	...
do.	do.	do.	do.	do.	...
do.	do.	do.	do.	do.	...
do.	do.	do.	do.	do.	...
do.	do.	do.	do.	do.	...
do.	do.	do.	do.	do.	...
do.	do.	do.	do.	do.	...
...	...	...	...	...	...
Complete HB. 32 in 33 with 97 rest; 21 in 24 with 93 rest	Complete HB. 26 in 28 with 63 rest; 29 in 30 with 161 rest	Half HB. 30 in 31 with 113 rest; 30 in 33 with 106 rest; 30 in 34 with 39 rest	Half HB. 59 in 66 with 138 rest; 30 in 31 with 155 rest	Half HB. 30 in 31 with 155 rest; 30 in 57	...
do.	do.	do.	do.	do.	...

TABLE

Understand "Days" after

Symbol.	Before 1914.	1904.	1905.	1906.	1907.	1908.
AF2	Yes	Complete HB. 18 in 21 with 358 rest	Complete HB. 25 in 25 with 117 rest	Half HB. 25 in 25 with 151 rest; complete HB. 25 in 27 with 310 rest	Complete HB. 41 in 60 with 222 rest	Complete HB. 31 in 38 with 331 rest
F2	...	do.	do.	do.	do.	do.
AF3	Yes	Complete HB. 18 in 39 or 40 with 117 or 118 rest	do.	as AF1	do.	do.
F3	...	do.	do.	do.	do.	do.
F4	...	do.	do.	as AF2	do.	do.
Ef	...	...	Director	...	...	...
Of	...	...	Burgess	...	as above	as above
Uf	...	...	Complete HB. 17 in 37 with 379 rest	Complete HB. 25 in 27 with 310 rest	do.	do.
AF3d	Yes	as AF3	as D	as D	as D	as D
AG1	Yes	Complete HB. 15 in 34 or 35 with 311 or 312 rest	Complete HB 25 in 25 with 169 rest	Complete HB. 25 in 26 with 235 rest	Complete HB 32 in 33 with 133 rest; 31 in 44 with 770 rest	...
G1	...	do.	do.	do.	do.	...
G2	..	Complete HB. 17 in 38 or 40 with 298 or 300 rest	do.	Half HB. 25 in 26 with 235 rest	do.	...
G3	...	Complete HB. 19 in 44 or 46 with 301 or 302 rest	do.	Complete HB. 25 in 26 with 235 rest	do.	...
AG4	Yes	Complete HB. 24 in 52 or 58 with 282 or 284 rest	do.	do.	do.	...
G4	...	do.	do.	do.	do.	...

I.—*Continued.*

each Numeral.

1909.	1910.	1911.	1912.	1913.	1914.
Complete HB. 32 in 33 with 97 rest; 21 in 24 with 93 rest	Complete HB. 26 in 28 with 63 rest; 29 in 30 with 161 rest	Half HB. 30 in 31 with 113 rest; 30 in 33 with 106 rest: 30 in 34 with 39 rest	Half HB. 59 in 66 with 138 rest; 30 in 31 with 155 rest	Half HB. 30 in 31 with 155 rest; 30 in 57	...
do.	do.	do.	do.	do.	...
do.	do.	do.	do.	do.	...
do.	do.	do.	do.	do.	...
do.	do.	do.	do.	do.	...
do.	do.	do.	do.	do.	...
do.	do.	do.	do.	do.	...
do.	do.	do.	do.	do.	...
as D	as D	do.	do.	do.	...
Complete HB. 30 in 30 with 88 rest.	Complete HB. 30 in 31 with 148 rest; 30 in 30 with 128 rest.	Half HB. 30 in 30 with 136 rest; 30 in 33 with 133 rest.	Half HB. 59 in 66 with 191 rest; 30 in 35 with 133 rest.	Half HB. 30 in 36 with 233 rest; 30 in 44	...
do.	do.	do.	do.	do.	...
do.	do.	do.	do.	do.	...
do.	do.	do.	do.	do.	...
do.	do.	do.	do.	do.	...
do.	do.	do.	do.	do.	...

TABLE

Understand "Days" after

Symbol.	Before 1904.	1904.	1905.	1906.	1907.	1908.
AG5	Yes	Complete HB. 24 in 52—58 with 282—284 rest	Complete HB. 25 in 25 with 169 rest	Half HB. 25 in 26 with 235 rest	Complete HB. 32 in 33 with 133 rest; 31 in 44 with 770 rest	...
G5	...	do.	do.	do.	do.	...
Og	...	...	Burgess	...	do.	...
AUG	Yes	...	Complete HB. 17 in 37 with 858 rest	...	do.	...
Ug	...	...	Complete HB. 17 in 37 with 236 rest; 25 in 25 with 169 rest	as above	do.	...
AJ1	Yes	Complete HB. 21 or 23 in 32 or 33 with 307-315 rest	Complete HB. 28 in 59 with 128 rest	Complete HB. 25 in 26 with 246 rest	Complete HB. 25 in 25 with 94 rest; 31 in 44 with 811 rest	...
J1	...	do.	do.	do.	do.	...
AJ2	Yes	Complete HB. 23 in 61 with 270 rest	do.	do.	do.	...
AZJ2	Yes	do.	do.	do.	do. except rest 503	...
J2	...	do.	do.	do.	as AJ1	...
AJ3	Yes	Complete HB. 28 in 43 with 286 rest	do.	do.	do.	...
AZJ3	Yes	do.	do.	do.	do. except rest 503	...
J3	...	do.	do.	do.	as AJ1	...
Ej	...	...	Director	...	...	...
AOj	Yes	...	Burgess	...	...	...
Oj	...	...	do.	...	..	...

I.—*Continued.*

each Numeral.

1909.	1910.	1911.	1912.	1913.	1914.
Complete HB 30 in 30 with 88 rest	Complete HB 30 in 31 with 148 rest; 30 in 30 with 128 rest	Half HB. 30 in 30 with 136 rest; 30 in 33 with 133 rest	Half HB. 59 in 66 with 191 rest; 30 in 35 with 133 rest	Half HB. 30 in 36 with 233 rest; 30 in 44	...
do.	do.	do.	do.	do.	...
do.	do.	do.	do.	do.	...
do.	do.	do.	do.	do.	..
do.	do.	do.	do.	do.	...
Complete HB. 31 in 32 with 94 rest	Complete HB. 30 in 32 with 47 rest; 30 in 31 with 114 rest; 30 in 31 with 155 rest	Half HB 31 in 34 with 153 rest; 30 in 32 with 53 rest	Half HB. 59 in 66 with 191 rest; 30 in 35 with 138 rest	Half HB. 30 in 37	...
do.	do.	do.	do.	do.	...
do.	do.	do.	do.	do.	...
Complete HB. 27 in 31 with 277 rest; 31 in 32 with 94 rest	do.	do.	do.	do.	...
as AJ1	do.	do.	do.	do.	...
do.	do.	do.	do.	do.	...
as AZJ2	do.	do.	do.	do.	...
as AJ1	do.	do.	do.	do.	...
do.	do.	do.	do.	do.	...
do.	do.	do.	do.	do.	...
do.	do.	do.	do.	do.	...

TABLE

Understand "Days" after

Symbol.	Before 1904.	1904.	1905.	1906.	1907.	1908.
Uj	...	...	Complete HB. 17 in 37 with rest; 28 in 59 with 138 rest	Complete HB. 25 in 26 with 246 rest	Complete HB. 25 in 25 with 49 rest: 31 in 44 with 811 rest	...
K1	...	...	...	Spiral without pricker 25 in 35 with 257 rest	Spiral 14 in 31 with 1042 rest	...
OK2	...	...	Burgess	Complete HB. 24 in 34 with 257 rest	Complete HB. 30 in 33 with 1040 rest	...
UK2	...	...	Complete HB. 17 in 37 with 1887 rest	...	...	...
K2	...	...	...	as OK2	as OK2	...
K3	...	...	...	Spiral with use of pricker, 25 in 25 with 267 rest	Spiral 30 in 33 with 1040 rest	...
EK4	...	...	Director	Complete HB. 25 in 25 with 267 rest	Complete HB. 30 in 33 with 1040 rest	...
OK4	...	...	Burgess	do.	do.	...
K4	..	...	...	do.	do.	...
EK5	...	...	Director	Double spiral with use of pricker, 25 in 25 with 267 rest	Double spiral 30 in 33 with 1040 rest	...
OK5	...	...	Burgess	do.	do.	...
K5	...	...	...	do.	do.	...

I.—*Continued.*

each Numeral.

1909.	1910.	1911.	1912.	1913.	1914.
Complete HB. 31 in 32 with 94 rest	Complete HB. 30 in 32 with 47 rest; 30 in 31 with 114 rest; 30 in 31 with 155 rest	Half HB. 31 in 34 with 133 rest; 30 in 32 with 53 rest	Half HB. 59 in 66 with 191 rest; 30 in 35 with 138 rest	Half HB. 30 in 37	...
...	Half HB. 26 in 29 with 160 rest; 31 in 33 with 150 rest	Half HB. 30 in 32 with 143 rest; 32 in 35 with 372 rest	...	Half HB. 31 in 34 with 250 rest: 30 in 41	...
...	Complete HB. 26 in 29 with 160 rest; 31 in 33 with 150 rest	do.	...	do.	...
..	do.	do.	...	do.	...
...	do.	do.	...	do.	...
...	Half HB. 26 in 29 with 160 rest; 31 in 33 with 150 rest	do.	...	do.	...
...	Complete HB. 26 in 29 with 160 rest; 31 in 33 with 150 rest	do.	...	do.	...
...	do.	do.	...	do.	...
...	do.	do.	...	do.	...
...	Half HB. 26 in 29 with 160 rest; 31 in 33 with 150 rest	do.	...	do.	...
...	do.	do.	...	do.	...
...	do.	do.	...	do.	...

TABLE

Understand "Days" after

Symbol.	Before 1904.	1604.	1905.	1906.	1907.	1908.
AK6	Yes	...	...	Complete HB. 20 in 33 with 267 rest	Complete HB. 17 in 33 with 1040 rest	...
EK6	...	...	Director	do.	do.	...
OK6	...	...	Burgess	do.	do.	...
K6	...	...	...	do.	do.	...
VM1	...	...	...	...	Basal Single cut. 30 in 33 with 8 rest; 33 in 41 with 663 rest	...
OWM1	...	...	Burgess	...	Basal pair of cuts 15 in 32 with 8 rest; 15 in 26 with 663 rest	...
WM1	...	...	...	...	...	...
M1	...	...	..	...	...	...
M2	...	...	...	...	...	...
VM3	..	...	...	...	Basal Single cut 30 in 33 with 8 rest; 33 41 with 663 rest	...
M3	...	..	...	...	...	...

I.—*Continued.*

each Numeral.

1909.	1910.	1911.	1912.	1913.	1914.
....	Complete H.B. 26 in 29 with 160 rest; 31 in 33 with 150 rest	Half HB. 30 in 32 with 143 rest; 32 in 35 with 372 rest	...	Half HB. 31 in 34 with 250; 30 in 41	...
...	do.	do.	...	do.	...
...	do.	do.	...	do.	...
...	do.	do.	...	do.	...
Half H.B. 30 in 33 with 35 rest; 28 in 30 with 114 rest	Complete H.B. 26 in 27 with 122 rest; 31 in 31 with 208 rest	Half H.B. 30 in 31 with 143 rest; 30 in 32 with 150 rest.	Half HB. 59 in 66 with 134 rest; 31 in 33 with 162 rest	Half HB. 30 in 36 with 203 rest	Half HB. 30 in 32
do.	do.	do.	do.	do.	do.
do.	do.	do.	do.	do.	do.
do.	do.	do.	do.	do.	do.
Two basal cuts, 30 in 33 with 35 rest: 28 in 30 with 114 rest	do.	do.	do.	do.	do.
Chain 30 in 33 with 35 rest: 28 in 30 with 114 rest	do.	do.	do.	do.	do.
do.	do.	do.	do.	do.	do.

TABLE

Understand "Days" after

Symbol.	Before 1904.	1904.	1905.	1906.	1907.	1908.
N	...	...	...	...	...	...
P	...	...	...	...	...	...
Q	..	...	...	...	...	...
AUR	Yes	...	Complete HB. 17 in 37 with 327 rest	Seven long oblique cuts, half spiral, 31 in 31 with 29 rest; 30 in 30 with 29 rest; 12 in 12 with 153 rest; 24 in 24 with 801 rest	...	...
S	...	...	...	Spiral 31 in 31 with 29 rest; 30 in 30 with 29 rest; 12 in 12	...	...
Z	...	...	...	..	...	...

I.—*Cotninued.*

each Numeral.

1909.	1910.	1911.	1912.	1913.	1914.
Complete HB. 34 in 40 with 152 rest; 29 in 37 with 60 rest; 26 in 31 with 102 rest	Complete HB. 30 in 30 with 139 rest; 30 in 30 or 31 with 199 or 200 rest	Half H.B. 30 in 30 with 138 rest; 30 in 31 with 109 rest	Half HB. 59 in 66 with 115 rest; 31 in 33 with 181 rest	Half HB. 30 in 36 with 207 rest	Half HB. 30 in 32
Two basal oblique cuts, 34 in 34 with 35 rest; 31 in 33 with 88 rest; Half H.B. 24 in 24 with 108 rest	Half H.B. 30 in 32 with 202 rest; 31 in 33 with 120 rest	Half H.B. 30 in 30 with 216 rest; 30 in 31 with 105 rest	Half HB. 59 in 66 with 234 rest; 32 in 33 with 162 rest	Half HB. 30 in 31 with 211 rest	Half HB. 30 in 30
...	...	...	...	Half HB. 37 in 45 with 225 rest	...
Seven long oblique cuts, 26 in 31 with 1,402 rest	..	...	Seven oblique long cuts, 20 in 20 with 348 rest	Seven oblique long cuts, 29 in 40	...
...	...	...	...	..	...
Presumedly complete HB. 27 in 31	..	....	..	...	...

Table II.

B. 1.	15 times tapped by two series of 5 superposed oblique cuts	
	255 times by a complete Herring-bone	
	242 times by a half Herring-bone ...	Total 612 days
B. 2.	15 times by scattered short cuts tree per diem, and after the first year, as B. 1	Total 612 days
C. 1.	16 times by two series of 5 superposed oblique cuts	
	98 times by a complete Herring-bone	
	34 times either by a complete Herring-bone or by Basals cuts	
	54 times by a complete Herring-bone	
	275 times by a half Herring-bone	Total 477
C. 2.	18 times by long Oblique cuts and after the first year, as C. 1 ...	Total 477
C. 3.	117 times by a complete Herring-bone	
	34 times either by a complete Herring-bone or by basal cuts	
	54 times by a complete Herring-bone	
	275 times by a half Herring-bone ...	Total 478
C. 4.	14 times by scattered slashes and after the first year, as C. 1 ...	Total 475
D. 1.	15 times by long Oblique cuts	
	86 times by a complete Herring-bone	
	27 times either by a complete Herring-bone or basal cuts	
	88 times by a complete Herring-bone	
	206 times by a half Herring-bone ...	Total 422
D. 2.	101 times by a complete Herring-bone	
	27 times either by a complete Herring-bone or basal cuts	
	88 times by a complete Herring-bone	
	206 times by a half Herring-bone	Total 422
D. 3.	23 times by scattered slashes and after the first year, as D. 1 ...	Total 430
D. 4.	15 times by a complete Herring-bone and after the first year, as D. 1.	Total 422
F. 1. & F. 3.	273 times by a complete Herring-bone	
	239 times by a half Herring-bone ...	Total 512

F. 2. & F. 4. 43 times by a complete Herring-bone
25 times by a half Herring-bone
205 times by a complete Herring-bone
239 times by a half Herring-bone ... Total 512

G. 1. 218 times by a complete Herring-bone
209 times by a half Herring-bone ... Total 427

G. 2. 42 times by a complete Herring-bone
25 times by a half Herring-bone
153 times by a complete Herring-bone
209 times by a half Herring-bone ... Total 429

G. 3. 222 times by a complete Herring-bone
209 times by a half Herring-bone .. Total 431

G. 4. 227 times by a complete Herring-bone
209 times by a half Herring-bone ... Total 436

G. 5. 29 times by a complete Herring-bone
25 times by a half Herring-bone
153 times by a complete Herring-bone
209 times by a half Herring-bone ... Total 416

J. 1. 251 or 253 times by a complete Herring-bone
180 times by a half Herring-bone ... Total 431 or 433

J. 2. 253 times by a complete Herring-bone
180 times by a half Herring-bone ... Total 433

J. 3. 258 times by a complete Herring-bone
180 times by a half Herring-bone ... Total 438

K. 1. 39 times in a Spiral
190 times by a half Herring-bone ... Total 229

K. 2. 111 times by a complete Herring-bone
123 times by a half Herring-bone ... Total 234

K. 3. 25 times by a Spiral, a pricker used after the knife
30 times by a Spiral
57 times by a complete Herring-bone
123 times by a half Herring-bone ... Total 235

K. 4. 112 times by a complete Herring-bone
123 times by a half Herring-bone ... Total 235

K. 5. 25 times by a double Spiral a pricker used after the knife
30 times by a double Spiral
190 times by a half Herring-bone ... Total 245

K. 6.	94 times by a complete Herring-bone 123 times by a half Herring-bone ...	Total 217
VM. 1.	63 times by a single basal Oblique cuts 58 times by a half Herring-bone 57 times by a complete Herring-bones 210 times by a half Herring-bone ...	Total 388
WM. 1.	30 times by a apair of basal Oblique cuts the rest as above, i. e., after the first year, as VM. 1 ...	Total 355
M. 1.	As VM. 1 and WM. 1, but without the first line	Total 325
M. 2.	30 times by two basal cuts 57 times by a complete Herring-bone 210 times by a half Herring-bone ...	Total 297
VM. 3.	63 times by a single basal cut 30 times by a chain-gamma 57 times by a complete Herring-bones 210 times by a half Herring-bone ...	Total 360
M. 3.	As VM. 3, but without the first line	Total 297
N.	179 times by complete Herring-bones 210 times by half Herring-bones ...	Total 389
P.	65 times by two basal Oblique cuts. 296 times by half Herring-bones ...	Total 361
Q.	37 times by half Herring-bone ...	Total 37
VR.	17 times by complete Herring-bones 172 times by seven long Oblique cuts	Total 199
S.	61 times by Spiral	Total 61
Z.	27 times by (it is believed) a complete Herring-bone ...	Total 27

As is common knowledge to readers of the Gardens' Bulletin, rubber seed is sold from the Gardens from little tapped trees. The seed bearers are the trees of the letters above, Q excepted. The maximum amount of tapping—on B—comes to less than 17 in every 100 days.

The old tapping rotation has been swept away. It entailed a great deal of unnecessary labour because the trees simultaneously tapped were scattered all over the rubber ground. It was stopped in March, 1914; and instead from May, 1914, the trees of the Gardens have been and will be tapped by blocks or fields as nearly as possible equal. The new arrangement was put into force when in 1914,

Mr. J. J. Bradbery temporarily joined the staff of the department, his planting knowledge peculiarly fitting him for the work. Another change was also initiated; the half herring-bone had always been to the right of the drainage channel; but from 1914 as far as the bark of the trees permits, it has been transferred to the left.

Block 1, as now constituted contains trees numbered between 23 to 416, and intercalations numbered, 1289, 2143 to 2145, 2160 to 2189, and 2505 to 2508. The trees with numbers up to 416 were planted in 1884-1887, except No. 362 and the intercalations which are much younger. Losses by death have been considerable in it. Of the now standing older trees, rather more than one half were tapped before 1904, seventeen were tapped by Mr. Burgess, in 1905 and five were tapped in the group called U. Very few trees escaped tapping in 1904, and those that were tapped fell into every possible group of tapped trees. Of the few trees which were not tapped in 1904, most were tapped in 1905 in one way or another and later (if tapped by Mr. Burgess) incorporated in a rotation. The trunks are much burred and tapping is now difficult. The block is on the left of the path in the lower figure of plate opposite page above.

Block 2, contains trees numbered 2509 to 3004, 3010 to 3042, 3045 to 3048 and 3051 to 3052. All were planted in the year 1904 and so are eleven years old. None were tapped before 1913, when they entered the rotation under the number 11, which in the tables 1 and 2 is indicated by the letter Q. In 1913 groups of trees received artificial manure in different ways, and the whole block was limed as a preparation. Except for the manuring, in age and treatment all the trees are exactly alike; they are evenly spaced, the lines intersected by ditches.

Block 3 contains trees numbered 832 to 1211 with the exception of trees 998 and 999, and contains also 2132, 2140 and 2141, 2134, 2137 to 2139, 3006 to 3008 and 2043 to 3049, as well as a few yet some way from flowering and not yet numbered. The trees with the lower numbers were planted in 1887 both rather irregularly and very much too closely. Only two of the now standing trees were tapped before 1904. A considerable number were tapped by Mr. Burgess (48) and the Director (20) in 1905. About one hundred went into rotation K, and nearly eighty into rotation J. At first no trees went into the rotations lettered B, C and D; but when trees were wanted to replace deaths in these some of them were taken from this Block. Very few went into G. In a general way it may therefore be said that the tapping of the block commenced only in a small way in 1904, chiefly in the rotation J, and a little in F, and that of the many trees untapped in that year, most were tapped either by Mr. Burgess or Mr. Ridley or in rotation K in the next year. In 1907 there was a fresh distribution of the trees not in any rotation, some going to rotation M, and others to various of the rotations and in 1907 another distribution occurred. The number of trees which have died is proportionately half of that in Block 1.

Blocks 4 and 5 are parallel to one another, and contain trees diverse in age. At the south and north ends of block 5 are irregularly placed old trees, the middle part being occupied by isolated older trees among young trees which except for unreplaced deaths are fairly regularly placed. The numbers lie between 435 and 686, 830 and 831, 1290 and 1681 excluding 1480 and 1674 to 1678. The older trees, those with numbers between 435 and 686 were planted—a few in 1884, the majority in 1887: trees 830 and 831 are of 1887. Exact records are lacking in regard to other trees, but their ages vary greatly. Very many trees have been lost from among the oldest. Of those still standing, only four were tapped before 1904. In that year about thirty went into rotation D, rather more into rotation F, twice as many into rotation G, and a few into J. In 1905 a few trees were tapped by Mr. Burgess. In 1909 nearly one hundred and twenty trees were put into rotation N. At the present date there are many trees still unripe for tapping.

Block 5 bears trees numbered between 687 and 828 with the exception of trees 809 to 819, and again between 1674 and 1996 except 1843 and 1844. There are many more old trees on the block than on block 5, the lower numbers among them being all recorded as planted in 1887. The planting is more irregular than anywhere else, and a large number of Casuarinas, Lagerstroemias, Sagos and Caryotas have been left intermixed until lately. Death has occurred extensively among the older trees, and especially from wind. Only one of the still standing trees was tapped before 1904. In 1904 sixty of the trees went into rotation F, G and J. In 1905, Mr. Burgess tapped a dozen other trees. In 1906 a few trees were tapped in rotation K, and in 1907 a few more in rotation M. One hundred more came into tapping in 1910, in rotation N and P. While over the years 1905 to 1912 various trees went into all the rotations except B and C for the replacing of others that had died. The tapping of the block has therefore been very diverse.

Block 6 is a small area with a slight slope containing all that are left of the oldest trees, intermixed with a great variety of other trees; in fact it is not a rubber block. The trees are numbered between 1 and 20, 1287, 2130, 2306, and 2826. The old trees had a variety of tapping, being the first used experimentally.

Block 7 like the last is not a rubber block, but contains scattered trees of Hevea, which bear the numbers 1220 to 1231, 1843 to 1844, 1860, 2114 and 2115, 2348 to 2350. They were seedlings either from seed beds or self sown. Several were tapped in 1907 as experiment W versus V, and then they went in 1909 into rotation M, where also others not tapped in the experiment were placed.

Adjoining block 5, with block 7 on its south side and block 12 on the east is a part of the Lower Garden kept under sago for the present, which will be used for rubber cultivation soon, and will then be divided into four blocks, Nos. 8-11. Scattered rubber trees have

been planted or sprung up self sown on its north side, which bear the numbers 807 to 819 and 1997 to 2113 and younger unnumbered trees are in its South-east conrer. Six were placed in 1908 in rotation M and two used in 1910 for replacing losses in rotation J.

Block 12 was planted up with Hevea in 1913 and has not been tapped yet. The trees bear the numbers between 3101 and 3511. Between every two rows is a ditch. The planting is regular. In 1913 the trees row by row were manured in different ways, otherwise they have all had the same treatment and are all of the same age.

Block 13 contains two rows of old rubber trees, bearing numbers between 1232 and 1254, and between 2116 and 2129, as well as some quite young trees. The old trees were planted in 1896 and 1897. All of them were tapped for 1909, in rotation M, but a few had been tapped in 1907, in the experiment W versus V.

Hevea trees occur in three groups on the Arboretum slopes. There are trees 1212 to 1215 close to the Economic Garden office, trees among which are Nos. 1255, 1256 and 2191 near the Dalvey road, and trees Nos. 1257 to 1281 and 2215 to 2248 near the Assistant Curator's quarters. There is also one numbered tree in the Botanic Gardens in the part nearest to the last, No. 1283. The number of then scattered trees used to be larger for very many associated trees were removed in 1911, on the building of the Assistant Curator's house. Most of such as still stand were tapped by Mr. Burgess in 1905. One was in rotation J from 1904 of another was used to replace a lost tree in rotation J from 1905, a third to replace a lost tree in rotation B from the same year, a fourth from 1909 in rotation G, and a fifth from 1912 in rotation M.

The number of trees in the Garden, which have been registered was about three thousand and three hundred, but the standing trees are now about three thousand. Latterly in trying to improve the plantation the removals have been considerable. In the following table an attempt is made to bring into one view the changes which have occurred in the number of trees of ten years and upwards. As regards most of the trees the age is fairly well known; it was recorded by Mr. Derry in a book, in the year, 1904, as stated in the *Annual Report of the Botanic Gardens* of that year; and similarly the age is known of the youngest trees; but there are a number of self-sown trees the age of which is uncertain. Judging from the girth measurements recorded in 1904, 1906, 1907 and 1909, these trees for the purpose of the table have been assigned to probable years; and though as regards individual trees the error may be considerable, as regards the trees taken collectively it is probably small. The deaths were not recorded before 1904, and are known approximately only for the year 1903. Allowance has been made for a fair proportion. From these trees seed crops have been collected as stated in tables.

TABLE IV.

The Gardens' Seed-Bearers.

Age.	1897.	1898.	1899.	1900.	1901.	1902.	1903.	1904.	1905.	1906.	1907.	1908.	1909.	1910.	1911.	1912.	1913.	1914.	1915.
10 years ...	1310	4	2	4	5	5	23	13	24	71	53	41	34	34	44	16	27	15	11
11 „ ...	95	1300	4	2	4	5	5	23	12	24	71	53	41	34	34	44	16	27	14
12 „ ...	—	90	1290	4	2	4	5	5	22	12	24	71	53	41	34	34	44	16	23
13 „ ...	42	—	85	1280	4	2	4	5	5	22	12	24	70	53	41	34	34	44	16
14 „ ...	—	40	—	80	1270	4	2	4	5	5	22	12	24	70	50	41	34	34	44
15 „ ...	—	—	38	—	75	1260	4	2	4	5	5	22	12	24	70	45	41	34	33
16 „ ...	—	—	—	36	—	70	1250	4	2	4	5	5	22	12	23	70	45	41	30
17 „ ...	—	—	—	—	34	—	60	1231	4	2	4	5	5	22	12	23	70	45	36
18 „ ...	—	—	—	—	—	32	—	35	1127	4	2	4	5	5	22	12	22	70	30
19 „ ...	—	—	—	—	—	—	30	—	34	1119	4	2	4	5	5	22	12	22	63
20 „ ..	9	—	—	—	—	—	—	23	—	34	1106	4	2	4	5	5	22	12	20
21 „ ...	—	9	—	—	—	—	—	—	20	—	32	1088	4	2	3	5	5	22	11
22 „ ...	—	—	9	—	—	—	—	—	—	15	—	32	1084	4	2	3	5	5	14
23 „ ...	—	—	—	9	—	—	—	—	—	—	11	—	32	1072	4	2	3	5	5
24 „ ...	—	—	—	—	9	—	—	—	—	—	—	11	—	32	1036	4	2	3	5
25 „ ...	—	—	—	—	—	9	—	—	—	—	—	—	10	—	32	1014	3	2	3
26 „ —	—	—	—	—	—	—	9	—	—	—	—	—	—	10	—	31	1072	3	2
27 „ ...	—	—	—	—	—	—	—	8	—	—	—	—	—	—	10	—	31	963	3
28 „ ...	—	—	—	—	—	—	—	—	8	—	—	—	—	—	—	9	—	31	863
29 „ ...	—	—	—	—	—	—	—	—	—	7	—	—	—	—	—	—	3	—	29
30 „ ...	—	—	—	—	—	—	—	—	—	—	6	—	—	—	—	—	—	2	—
31 „ ...	—	—	—	—	—	—	—	—	—	—	—	6	—	—	—	—	—	—	2
32 „ ...	—	—	—	—	—	—	—	—	—	—	—	—	6	—	—	—	—	—	—
33 „ ...	—	—	—	—	—	—	—	—	—	—	—	—	—	6	—	—	—	—	—
34 „ ...	—	—	—	—	—	—	—	—	—	—	—	—	—	—	6	5	—	—	—
35 „ ...	—	—	—	—	—	—	—	—	%	—	—	—	—	—	—	—	5	—	—
36 „ ...	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	4	—
37 „ ...	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	3
38 „ ...	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Total ..	1447	1434	1428	1406	1403	1391	1392	1353	1267	1324	1357	1378	1408	1430	1436	1419	1397	1400	1270

Only approximate.

TABLE V.

The Gardens' Seed-Crop.

YEAR.	January.	February.	March.	April.	May.	June.	July.	August.	September.	October.	November.	December.	Total.
1897 ...	...	....	1,400	2,400	1,260	3,100	2,600	2,200	4,175	2,300	900	...	20,335
1898 ...	7,250	35,550	32,505	13,600	1,750	1,200	...	...	2,950	15,200	3,300	....	113,305
1899 ...	2,150	850	3,500	2,150	600	...	100	3,900	121,970	21,850	...	500	157,570
1900 ...	..	8,200	13,500	3,000	...	1,000	...	2,200	46,300	57,000	8,100	2,400	141,700
1901 ...	7,500	15,600	44,200	3,200	...	...	...	2,000	19,000	49,675	10,000	1,000	152,175
1902 ...	...	...	..	4,050	6,300	14,400	...	3,000	22,700	55,390	20,170	900	126,910
1903 ...	...	400	32,400	14,680	3,950	...	....	...	1,575	5,650	19,100	17,150	94,905
1904 ...	9,654	7,500	19,450	500	2,000	1,500	500	2,700	22,250	75,000	21,250	3,875	166,179
1905 ...	2,200	3,000	..	1,400	...	...	6,550	34,900	86,600	37,000	1,000	..	172,650
1906 ...	...	2,170	5,030	3,360	25,025	6,750	3,075	12,175	49,450	16,720	10,350	11,250	145,355
1907 ...	38,850	52,400	36,900	7,250	1,400	750	...	12,000	73,300	105,000	38,000	1,000	366,850
1908 ...	...	...	...	...	...	3,000	...	12,000	12,000	128,000	120,000	40,600	315,600
1909 ...	...	15,000	40,100	29,000	...	...	...	10,600	6,000	70,200	67,200	46,300	284,400
1910 ...	21,000	71,400	61,200	...	2,400	1,600	...	30,000	9,600	38,600	...	83,050	318,850
1911 ...	73,900	28,800	43,800	....	...	...	5,400	64,800	57,600	40,000	5,400	5,500	325,200
1912 ...	600	3,000	...	2,000	5,000	...	...	...	18,800	101,100	38,000	30,600	199,100
1913 ...	...	...	....	6,600	...	6,000	...	2,400	5,400	3,800	16,200	38,400	78,800
1914 ...	40,800	188,100	21,400	...	...	...	...	...	20,400	41,100	49,000	...	360,800

The average crop calculated on the whole of the eighteen years was 196,143 seeds. To eliminate the variation due to seasons, we may take the average of each five years, and then we get :—

Table VI.

Average of years	1897-1901	...	...	117,017
„	1898-1902	...	...	138,172
„	1899-1903	...	...	134,472
„	1900-1904	...	...	136,194
„	1901-1905	...	...	142,384
„	1902-1906	...	...	141,020
„	1903-1907	...	...	189,188
„	1904-1908	...	...	233,327
„	1905-1909	...	...	256,971
„	1906-1910	...	...	286,211
„	1907-1911	..	...	322,180
„	1908-1912	...	...	288,630
„	1909-1913	...	...	241,270
„	1910-1914	..	...	256,530

The later figures show crops consistently larger figures than the average, the change commencing as table V shows with 1907.

It is not clear to what the increase is to be ascribed, though something may have been done by means of more thorough collecting ; and as commencing in 1904 the grass under the trees was cut over more often in order that the collecting might be better, the trees obtained a little more cultivation than they had, which increased, until now they are clean weeded, except in Blocks 6 and 8.

The yield of the years from 1907 forwards was at the rate of 281,200 seeds per annum, which at 144 seeds to the pound would be nearly 2000 lbs. per annum from about 1,400 trees, or of kernels about 1,200 lbs : and if these yield 42 per cent. of oil the return in oil amounts to just over 500 lbs. It is not convenient to write of the worth of this oil here :—a discussion on that subject with more details will be given in a later issue of this Bulletin. But meanwhile the Gardens records are useful in furnishing a rough estimate of what might be collected of this secondary product from matured rubber estates, where of course tapping would be more extensive than in the gardens, but the spacing of the trees much more appropriate.

That the trees, as is quite to be expected, tend to exhaust themselves in seeding, is evident from the way in which a particularly large cups is generally the sequel of a failure to seed, and is generally followed by a failure in the next seeding season falling about half a year later.

This is how the crops followed one another in the Economic Gardens, Singapore as shown by the records used in drawing up Table VI.

Year.	Early crop.	Late crop.
1897 ...	Insignificant	Small
1898 ...	Rather small—80,000	Small
1899 ...	Insignificant	Rather large—140,000
1900 ...	Small	Rather large—100,000
1901 ...	Rather small—60,000	Rather small—75,000
1902 ...	Small	Rather large—100,000
1903 ...	Rather small	Small
1904 ...	Small	Rather large—120,000
1905 ...	Insignificant	Large—150,000
1906 ...	Rather small	Rather small—90,000
1907 ...	Large—110,000	Very large—200,000
1908 ...	Insignificant	Very large—250,000
1909 ...	Rather small—70,000	Rather large—140,000
1010 ...	Rather large—140,000	Rather small
1911 ...	Rather large—140,000	Large—160,000
1912 ...	Insignificant	Rather large—140,000
1913 ...	Insignificant	Rather small—50,000
1914 ...	Very large—240,001	Rather large—110,000

I. H. B.

The

Gardens' Bulletin

STRAITS SETTLEMENTS,

into which is incorporated all that has been published as the third series of the Agricultural Bulletin of the Straits and Federated Malay States.

Vol. I. Issued August, 31st, 1915. No. 9.

CONTENTS.

	PAGE.
Some Notes on Philippine Yams and the results of cultivation of three Indian races in 1914	297
Preparation of Yams for the Table	304
Different parts of the tubers of Dioscorea alata sprout at different rates	306
Three Lepidoptera which attack Dioscoreas in Singapore	308
Fragments of Malayan Geographic Botany—No. I. Enumeration of Pahang plants collected by the late A. M. Burn-Murdoch	310
Orchid Notes	318
The Singapore Prickly-Pear	320
A nest of living Drymoglossum piloselloides	321
Kenari seeds, Canarium rufum	322
One hundred miles for blow-pipe poison	323
Rainfall at the Botanic Gardens, Singapore, in 1914	324
Rainfall at the Waterfall Gardens, Penang, in 1914	326
Summary of rainfall	328
Cadamustus typicus, a minor coconut pest	329
A very destructive flash of lightning	329
Borrowings from new books	329

To be purchased at the Botanic Gardens, Singapore; from Messrs. Kelly and Walsh, Ltd., No. 32 Raffles Place and 194 Orchard Road; and the Straits Times Office, Cecil Street, Singapore.

DEPARTMENTAL NOTICE.

Plants of the Avocado or Alligator Pear—*Persea gratissima,*—a few plants of the Brazil nut—*Bertholletia excelsa,*—and a few plants of *Eucalyptus corymbosa* to be sold within the Peninsula at fifty cents each.

Seeds of *Hevea brasiliensis*--Para Rubber—as available from trees, twenty-eight years old, to be sold at three dollars per thousand up to the number of ten thousand, and at two dollars and fifty cents for every further thousand on the same order.

THE

GARDENS' BULLETIN,

STRAITS SETTLEMENTS.

INTO WHICH IS INCORPORATED ALL THAT HAS BEEN PUBLISHED AS THE THIRD SERIES OF THE AGRICULTURAL BULLETIN OF THE STRAITS AND FEDERATED MALAY STATES.

The Gardens' Bulletin is published as material becomes available. Its price is fifty cents a copy, post free, or in advance for a volume of twelve numbers, post free,

Five dollars in the Straits and Federated Malay States.

Nine and a half rupees in India and Ceylon.

Thirteen Shillings in Europe.

Subscriptions paid to the third series of the Agricultural Bulletin, Straits and F. M. S., are counted as subscriptions to it.

SINGAPORE :
THE STRAITS TIMES PRESS, LIMITED.

THE

GARDENS' BULLETIN,

STRAITS SETTLEMENTS.

Vol. 1. Issued August 1915. No. 9

SOME NOTES ON PHILIPPINE YAMS, AND THE RESULTS OF CULTIVATION OF THREE INDIAN RACES IN 1914.*

I. Dioscorea alata, Linn.

By the kindness of Professor C. F. Baker, of the University of the Philippines and of the Department of Agriculture, Manila, through Mr. O. W. Barrett, the Botanic Gardens received in January, 1914, upwards of eighty yam-tubers for experimental cultivation. For the most part there was one tuber of each supposed race that the two Institutions had.

To accomodate the consignment five trenches were prepared two and a half feet deep in the yellow soil of the Botanic Gardens just behind the Director's house, and filled with alternating layers of the soil and manure.

The tubers from Manila was planted in these trenches at a distance from each other of two feet, in the month of January; and along with them were planted a few yams of local origin. The shoots began to appear above ground in March and continued to do so until May was in. The whole crop was dug in October; the new tubers were examined and weighed; and notes made upon them.

In the current year, 1915, experiments are being made on a larger scale, for which purpose the tubers of the whole crop of 1914 were cut up into sets, each of about 2 lbs. weight or 810 grammes, and has been planted.

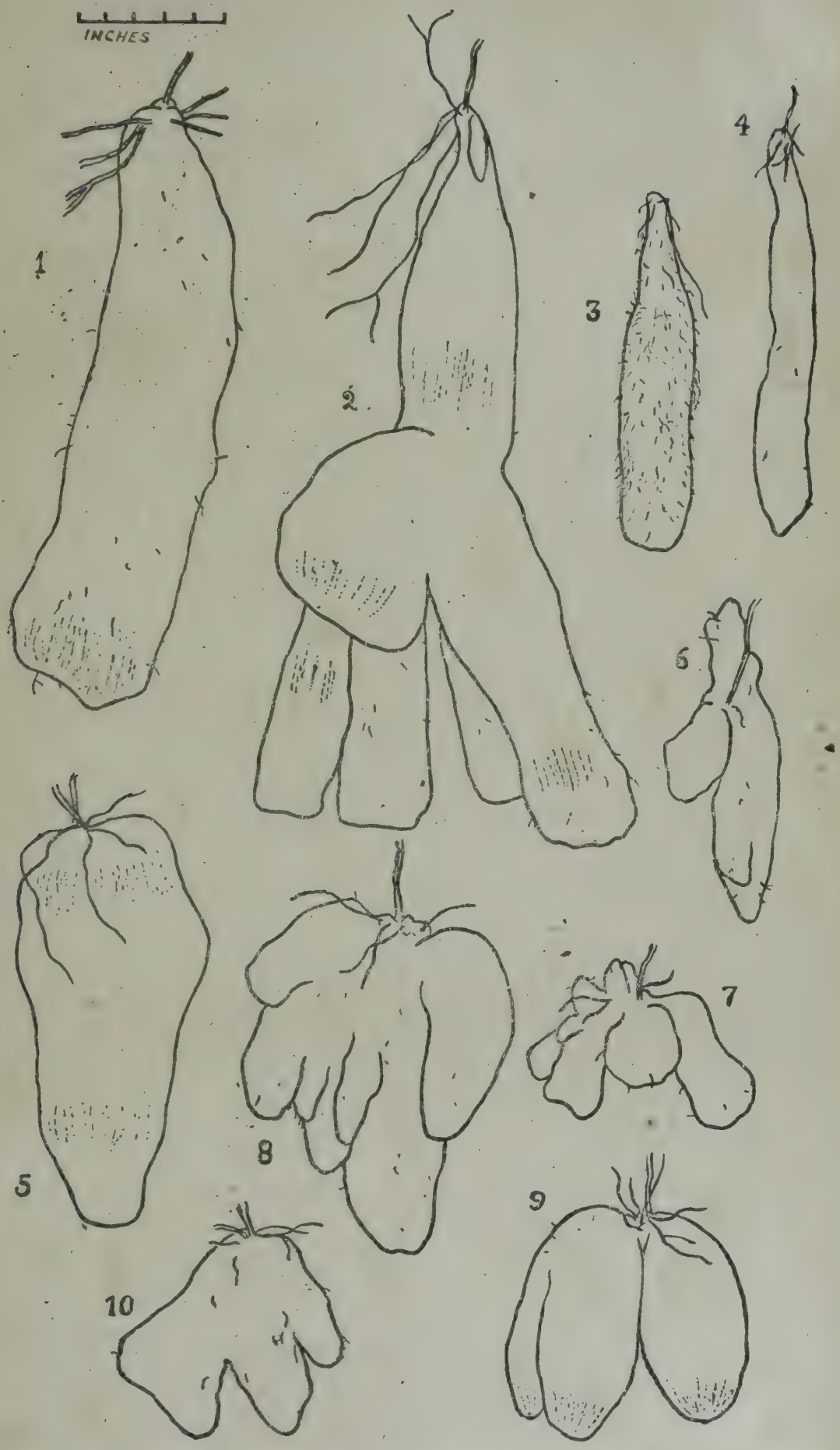
* A report on Philippine yams may be found in the Philippine Agriculturist and Forester, III., 1915, pages 205-209.

The largest yam produced in 1914, was one of local origin, the parent tuber having been found in the deserted garden of the Government bungalow on the top of Bukit Timah; it weighed 17 lbs. 8 oz. or almost 8 kilogrammes; and as it was still in full growth, when dug, it would have attained considerably more, say, by January in which month the plant of 1913 was still green. Next to it in weight was a yam of Philippine origin which weighed 16 lbs. 9 oz. or 7513 grammes (see page 299 figure 2.) The third tuber in size was also of Philippine origin and weighed 12 lbs. 6 oz. or 5613 grammes. In appearance it was almost exactly as the tuber of the Bukit Timah plant, but there was this difference between the plants that the stem of the Bukit Timah plant produced a profusion of bulbils, whereas that of the Philippine plant did not. The tuber which came fourth in weight was from a Philippine plant numbered 1054, (page 299 figure 1); it differed from the preceeding a little in the surface of the tuber and in its foliage; its weight was 9 lbs. 13 oz. or 4450 grammes. Plant no. 1042, (page 299 figure 5) produced a not altogether dissimilar tuber weighing 7 lbs. 7 oz. or 3373 grammes. All these big bulky tubers except no. 1057, (page 299 figure 2) were without purple sap.

Attention may be called to the slight difference in shape between the tubers 1054 (page 299 figure 1) and 1042 (page 299 figure 5) in order to make the comment that it has been man's endeavour in selecting yams to obtain something which does not give great labour in digging, i.e. something surface-rooting. From such a point of view no. 1042 (page 299 figure 5) is an improvement on no. 1054 (page 299 figure 1), and both are an improvement upon the Bukit Timah race which buried itself to a depth of 28 inches.

Some of the deep burying yams are however very tender, and are thought, by jungle tribes particularly, a much desired food, so that they laboriously dig them out. One object therefore which man must have had in view in his work of selecting would be the preservation of the delicacy of substance while getting rid of the deep burying. Rumpf relates that in his time (1653-1720) in Celebes the inhabitants had a way of circumventing the yams which was by compelling them to grow through horizontal bamboos placed in the surface of the soil. The modern use of such a device is unrecorded; but the Philippine yams possess, in one little group, no tendency to bury, though elongating considerably. For instance no. 956 (page 301 figure 3) recurved back and actually extruded the tip of its tuber from the soil. No. 943 (page 301 figure 4) behaved similarly. Nos. 935 (page 301 figure 5) and 945 (page 301 figure 6) while differing slightly also extruded their tuber-tips, and Nos. 1095 (page 301 figure 1) and 960 (page 301 figure 2) instead of growing down, elongated more or less horizontally, the larger to a length of 20 inches.

Because of their great interest, all the tubers raised of this type are here figured, though we may not have among them more than three races. It may be remarked further that they all had purple sap.



Dioscorea alata—Philippine races, which descend more or less into the earth.

The largest, from no. 945 (page 301 figure 6), weighed 8 lbs., 14 oz. or 4025 grammes and out of the whole collection, among those containing purple sap was the third in weight. No. 655 (page 301 figure 5), which differed in very little, weighed 8 lbs. 5 oz. or 3770 grammes. These two, being apparently of one race, will be kept in mind specially on account of their combination of surface production and productiveness; but of their comestible qualities we know nothing as yet.

Figures 3 and 4 on page 299 (of tubers numbered 3790 and 1056) are reproduced to call attention to the way in which tubers vary in rootiness. Both the two tubers are deeply penetrating, the longer being 14 inches (35½ cm.) long. Another penetrating tuber was grown, intermediate in rootiness and therefore not reproduced here, (no. 1692), which with a length of 24 inches (61 cm.) had a weight of only 3 lbs. or 1361 grammes. On the other hand no. 1055 (page 1 figure 9) while penetrating only 8 inches (20 cm.) produced 4 lbs. 11 oz. (2125 grammes) of tubers, and no. 3793 penetrating 12 inches (30½ cm.) produced 10 lbs. 5 oz. or 4678 grammes.

The last mentioned had a prickly stem, and so had no. 3790 and another very similar plant, no. 1019. It may be remarked that the prickliness is not associated with any particular form or colour of tuber, or any particular form of foliage.

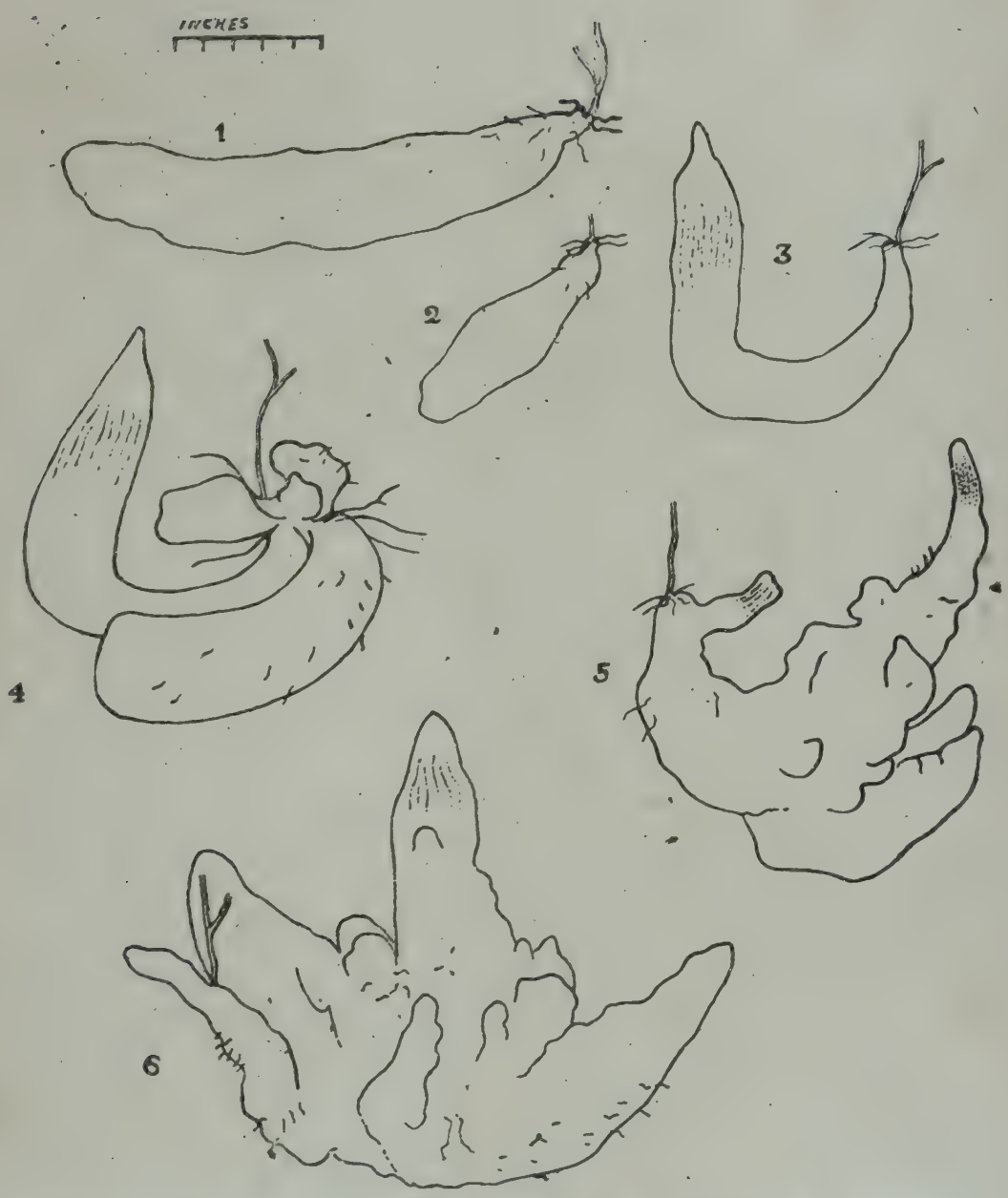
The lesser tubers grown were for the most part fingered in various ways, e.g. nos. 1019, (page 299 figure 8) and 931, (page 299 figure 7); and for the most part they carried purple sap. The relation of the extent of surface to flavour, etc., if any, has yet to be determined; but it is quite probable that there is some relationship.

The Oebi merah of the Singapore markets, grown along with the Philippine yams, ranked with the largest of the fingered ones; but it differed in foliage very markedly, and yet more by producing a great abundance of bulbils.

There were among the Philippine yams two tubers (nos. 1040 and 1046) forked rather than fingered, 12 and 15 inches long, (30½ and 38 cm.) respectively, without purple sap, of a form which leads from the simple elongated shape to the flat condition wherein branching occurs in one plane only. Of flat tubers no. 1031 (page 299 figure 10) was an example. This flattening is probably to be considered as a fasciation.

Two tubers only with uprising fleshy shoots were found. One is figured which was received as "alata from Manila" (page 299 figure 6). These uprising shoots appear in the end of one season, grow thick and store food, to shoot out in the following season; they are cases of growth such as is usually made after the resting period being made in advance of it. In the figure two fleshy shoots may be seen by the side of the old dying stem of the finished season.

One of the plants with uprising shoots had purple sap and the other had not.



Dioscorea alata—Philippine races, which do not descend into the earth.

Some of the Yams showed themselves earlier than others both in sprouting and in the withering of their shoots: but further investigations are necessary in order to demonstrate what races are early and what are late, especially as in the start of the season much depends upon the part of the parent tuber used as a set (see pp. 306-307).

2. Dioscorea aculeata, Lamk., *the lesser yam.*

In this Bulletin on page 227 attention was called to the appearance in Singapore island of the lesser yam, and on the following page to its appearance in the Province Wellesley. Since those lines were printed, the yam has been found in the garden of a Kling at Durian Tunggal, Malacca.

With the advent of cultivators other than Malays into the Colonies, there is considerable probability that it will attract more and more interest, and that small patches will appear elsewhere. The Kling at Durian Tunggal said that he had himself brought the parent tubers from India.

This lesser yam in the eastern tropics has a rather general cultivation from India to Papua. In India its chief centres are the Nerbudda valley, the Behar plains, and upper Assam; but it is by no means uncommonly grown in the south. It may be found in Burma, the Shan Hills, and French Indo-China; in the Philippine islands it is quite an important article of food, and in north-eastern New Guinea it is said to be the most important of all roots. South-westwards from the Philippine islands and New Guinea it is met with. It was stated by the celebrated Rumpf that in his time (1653-1720) it had rather recently acquired an extension from the east of the Archipelago to the neighbourhood of Batavia where men, chiefly immigrants from that direction had a penchant for growing it. Despite this extension upon the west, north and east of the Peninsula, despite the going and coming between India and Malaya, Siam and Malaya, despite the Bugis invading and the Dutch and Portuguese trading from islands where it is commonly cultivated, it seems not to have obtained a place between the Isthmus of Kra and Singapore until recently: and this can only be ascribed to a want of interest in its cultivation as from so many of the adjoining lands there must have been thousands of opportunities of bringing it had Malay cultivation but room for it. It had not however. But with the advent of settlers whose cultivation is deeper—Kling and Chinese—there would seem to be room for more yams and especially for the lesser yam. Under this impression experiments were commenced at Singapore in 1912 when three races of *D. aculeata* received from India were first planted in the Economic Garden.

These races from India were,

Goradu from Akola, Berar	...	No. 33,346
China alu from Jorhat in Assam,		No. 34,383
Pora alu from Chittagong.	...	No. 34,125

A root of each had been received from Major A. T. Gage, Superintendent of the Royal Botanic Gardens, Calcutta, in the end of 1912, and the tubers were planted in the Economic garden.

Thirty plants in all were grown. Seven were raised from tubers of Goradu, ten from China alu and thirteen from Pora alu.

The seven plants of Goradu gave in turn 4½ lbs. of tubers, the ten of China alu 5¾ and the thirteen of Pora alu 31¼ lbs.

These sown again in 1914 returned:—

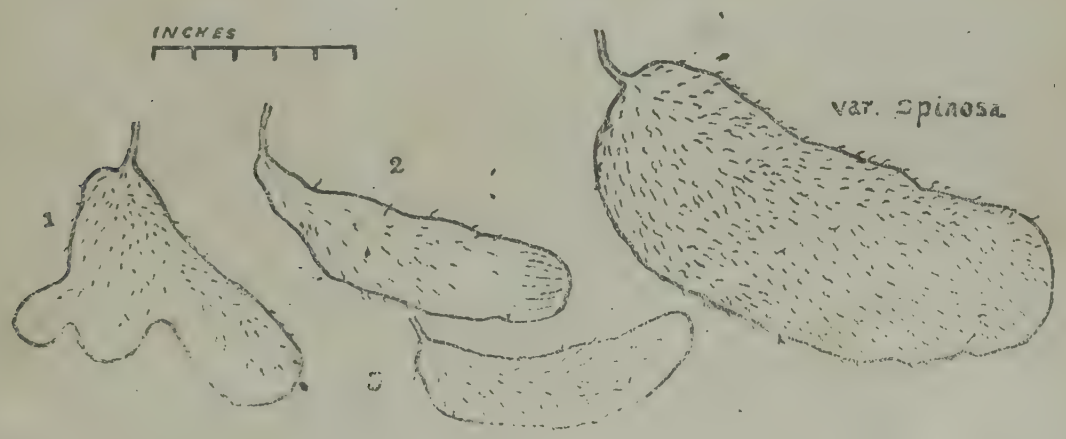
No. 34,125	311 yams	weighing	154½ lbs.	or 70	kilogrammes.
No. 33,346	100 „	„	46 „	or 21	„
No. 34 383	200 „		28 „	or 12½	„

The tubers of the first ran up to 3 lbs. or 1460 grammes, those of the second to 2¾ or 1,247 grammes, but those of the third were not above 1 lb. or 454 grammes in weight.

The rate per acre works out at:—

No. 34,125	21,851 lbs.	per acres or	9,932	kilogrammes.
No. 33,346	13,011 „	„	5,902	„
No. 34,383	7,820 „	„	3,593	„

The greatest yield is greater than the best expected of potatoes in particulary fertile districts of Europe. But then the plot was very small (28 feet by 22 feet) containing four rows of plants sown in well manured trenches.



Dioscorea aculeata—four Philippine races.

Along with the greater yams from the Philippine islands, described in the preceeding pages, were grown four races of the lesser yam from the same sources, typical roots of which are figured here in outline.

Collectively the races are there called in the Tagalog language Tugui a name like that, Tu-cu, used in Annam.

They occur both wild and cultivated and those that are wild produce copious thorns on the roots. Thorns, however, are not a sure distinguishing mark of wild races, for at least elsewhere some cultivated races possess them, e.g. one which is in favour in Central Burma and is there called Wet-ka u or Pig-cut-off yam because of the way in which the thorns protect the tubers from the depredations of the wild pigs.

The plants of the first Philippine race,—whether of wild or cultivated origin I have not been informed,—produced the large tubers (as figured on the right) and with these such thorny roots. These tubers however were diffuse and placed far beyond the protection of the thorns present, a circumstance suggesting that we have in it a cultivated race, the thorns left being indications of a not remote origin from the wild state. The tubers were few in number but attained as much as 5 lbs. 6 oz. (2439 grammes) in weight. The other three races were without thorny roots and distinguished as follows:—

a. Tubers elongated, with a slight tendency to be diffuse, reaching in weight 1 lb. 8 oz. (640 grammes).

b. Tubers small, many, closely bunched, attaining in weight 4 oz. only (113 grammes).

c. Tubers lobed, few, and some of them rather large, attaining in weight 1 lb. 5 oz. (596 grammes).

The figures given are drawn exactly to scale: *a* is numbered 2; *b* is numbered 3; and *c* is numbered 1.

The races will be the subject of further experiments in 1915, when they will be tested against those brought from India and against others newly received from Saigon.

PREPARATION OF YAMS FOR THE TABLE.

Europeans in the East do not know, how to cook yams: therefore the following recipes are reproduced from one of the publications of the Imperial Department of Agriculture for the British West Indies.

Roasted Yams.—Lay a yam before the grates of the stove or in the oven, turning it occasionally until cooked, scrape off the outer skin, cut into pieces or mash with butter; serve hot.

Baked Yams.—Pare a yam, put it in the oven and bake until soft, take it out of the skin, mash with butter, put back into the skin; cut in pieces and serve hot.

Boiled Yams.—Pare a yam, put it into boiling water, cook until tender; serve whole.

Yam Chips.—Pare a yam and boil until tender, cut it in chips; fry in boiling lard and serve hot.

Yam Rice.—Pare a yam and boil until tender; press through a colander onto a hot dish; shaking the colander lightly every few seconds, to cause the yam to fall off in short grains like rice; serve very hot.

Yam Rissoles.—Pare, boil and mash a yam with pepper and salt, and if liked, a little minced parsley; shape into rissoles, cover with egg and bread crumbs, and fry until a light brown.

Yam Border.—Pare, boil and mash a fairshaped yam, about two pounds in weight, and add to it two tablespoonful of butter, half a cup of boiling milk, one tablespoonful of salt, the yolk of two eggs (well beaten); beat the mixture until very light; butter a border mould, pack the yam in it, and let it stand for eight minutes, beat the whites of the eggs to a froth, add salt, turn out the yam, cover with the whites and put in an oven to brown; take from oven and fill the centre with meat or flesh heated in a sauce.

Yam au Choux.—Take one pound of boiled yam, one boiled cabbage, two tablespoonful of cream, one ounce of butter, with salt and pepper to taste; rub the yam and cabbage through a wire sieve, mix together with butter, cream and seasoning; pile upon a dish, and serve with fried croutons of bread around. Serve very hot.

Porcupine Yam.—Take two pounds of yam, boil and mash with one egg and salt to taste; shape and roll in beaten egg and vermicelli; fry. Serve hot with parsley.

Yam Fritters.—Pare and boil half a pound of yam until soft, beat lightly with a fork; beat the yolks of four and the white of three eggs, add two tablespoonful of cream, two tablespoonful of wine, one dessertspoonful of lemon juice and half a teaspoonful of grated nutmeg; beat all altogether until extremely light, put plenty of lard into a frying pan and drop a tablespoonful of the butter at a time into it, and fry the fritters to a nice brown. Serve with wine sauce (served separately), or only sprikle powdered sugar over them.

Yam Pudding.—Take half a pound of yam, two eggs, one lemon, two ounces of butter, two ounces of sugar; pare and boil the yam, and rub it through a sieve while hot; beat the butter and the yam together, and allow the whole to cool; break the eggs and separate the yolks from the whites; beat the yolks until light, and add sugar, the juice of a lemon as well as the grated rind, and the yam. Whisk the whites to a stiff froth and stir lightly in before baking; put in a well buttered dish and bake in a brisk oven for twenty minutes.

Yam en Brun.—Cut up one pound of yam already boiled, and fry to a light brown; sprinkle thickly with chopped parsley and shalat or mushroom, pepper, salt and lime juice; serve very hot.

DIFFERENT PARTS OF THE TUBERS OF DIOSCOREA ALATA SPROUT AT DIFFERENT RATES.

In the Journal of the Asiatic Society of Bengal 1911, p. 467. I gave an account of observations on the bulbils *Dioscorea bulbifera*, Linn., showing that shoots are more freely formed from the basal part of the bulbil than from the apical; and that if the bulbil be halved the shoots are generally produced towards the base on either half but, that sprouting is quickest on the lower halves. I here give some observations made on the tubers of *Dioscorea alata*, which show that in them the older parts more quickly sprout than the younger. The result is as would be expected, but to demonstrate it was desirable, in connection with observations in hand on the earliness or lateness of various races under study; for when we have recognised that sets cut from different parts of a tuber send out shoots relatively quickly or relatively tardily according to the position from which they have been taken, we are one step forward from the danger of comparing the unequal in attempting the separating out of precocious and late races.

The observations have been made in this way. Taking all the tubers reported on in the preceeding note pp. 297-302, they were cut up into sets of about two pounds weight each, and planting was done on December 2nd, 1914, in such way that the oldest part of each tuber was towards one end of the trenches dug for the crop, and the youngest parts towards the other end. The sets, which had previously been treated carefully with potassium permanganate and dried until the cut surfaces were hard, were earthed over to a depth of about four inches and then the appearance of their shoots above ground was watched for and recorded in the number of days which on their emergence had elapsed from planting. The following table details the result: in the first column is the number or name under which the race has been grown, in the other columns are the number of days between planting and the appearance of the shoots above ground. The reader will see that a lesser period is generally recorded in the second column than in the others and that the period lengthens towards the right, i.e., towards the tip of the tuber. As some of the tubers were branched e.g., that figured as No. 2 on page 299, the order in which the parts were placed could not he made in every case to represent exactly the actual tuber, but nevertheless the general result is quite obvious, namely, that the more or less woody top of the tuber is the most ready to sprout and the tip least. As man usually keeps the top for propagation and eats the tip, which it the most esculent, in so doing he gets the advantage for his planting of using that part which nature has most ready for the purpose.

There is evidence in the table that races vary considerably in precocity or lateness, thus the latest named yam showed itself most distinctly earlier in sprouting than the one immediately before it: and the yams which were figured on page 301 showed themselves late; but these and other similar observations will be the subject of another report, when more statistics are available.

Number of days from December 2nd. which elapsed before Shoots appeared above Ground.

Registration Number of root.	Top Set.	Lower sets, more or less in descending order.												
940 Philippines...	30	23	55	78	—	—	—	—	—	—	—	—	—	—
947 „ ...	24	48	51	—	—	—	—	—	—	—	—	—	—	—
938 „ ...	40	40	—	—	—	—	—	—	—	—	—	—	—	—
1,025 „ ...	58	35	64	89	—	—	—	—	—	—	—	—	—	—
1,019 „ ...	14	94	81	64	106	—	—	—	—	—	—	—	—	—
1,387 „ ...	49	52	—	—	—	—	—	—	—	—	—	—	—	—
2,712 „ ...	25	27	62	—	—	—	—	—	—	—	—	—	—	—
958 „ ...	61	76	78	78	78	110	—	—	—	—	—	—	—	—
824 „ ...	23	44	—	—	—	—	—	—	—	—	—	—	—	—
1,031 „ ...	53	52	—	—	—	—	—	—	—	—	—	—	—	—
"Unknown," from Manila ...	82	89	106	108	—	—	—	—	—	—	—	—	—	—
1,044 Philippines...	43	61	—	—	—	—	—	—	—	—	—	—	—	—
963 „ ...	43	41	81	64	—	—	—	—	—	—	—	—	—	—
329 „ ...	17	51	24	25	77	—	—	—	—	—	—	—	—	—
3,790 „ ...	90	108	—	—	—	—	—	—	—	—	—	—	—	—
937 „ ...	47	68	49	75	—	—	—	—	—	—	—	—	—	—
1,023 „ ...	21	61	75	—	—	—	—	—	—	—	—	—	—	—
1,042 „ ...	15	23	23	53	—	—	—	—	—	—	—	—	—	—
1,055 „ ...	90	63	61	—	—	—	—	—	—	—	—	—	—	—
3,793 „ ...	24	23	24	23	82	48	96	—	—	—	—	—	—	—
1,054 „ ...	20	37	39	39	40	—	—	—	—	—	—	—	—	—
955 „ ...	13	41	108	79	—	—	—	—	—	—	—	—	—	—
1,095 „ ...	46	106	45	—	—	—	—	—	—	—	—	—	—	—
1,056 „ ...	40	52	—	—	—	—	—	—	—	—	—	—	—	—
1,692 „ ...	23	89	82	64	—	—	—	—	—	—	—	—	—	—
No Number, from Manila ...	37	79	23	—	—	—	—	—	—	—	—	—	—	—
1,057 Philippines. .	94	40	52	52	51	53	60	51	64	56	53	55	—	—
1,046 „ ...	84	85	103	—	—	—	—	—	—	—	—	—	—	—
1,040 „ ...	85	110	124	—	—	—	—	—	—	—	—	—	—	—
945 „ ...	39	94	54	112	130	—	—	—	—	—	—	—	—	—
943 „ ...	90	90	58	110	106	—	—	—	—	—	—	—	—	—
956 „ ...	94	110	110	—	—	—	—	—	—	—	—	—	—	—
960 „ ...	20	37	—	—	—	—	—	—	—	—	—	—	—	—
330 „ ...	20	38	—	—	—	—	—	—	—	—	—	—	—	—
Oebi merah of Singapore ...	63	89	125	89	85	90	64	*	110	37	—	—	—	—
Oebi from Bukit Timah ...	13	13	11	13	13	12	23	20	14	12	37	23	35	35

* Destroyed by slugs.

I. H. BURKILL.

THREE LEPIDOPTERA WHICH ATTACK DIOSCOREAS IN SINGAPORE.

In the course of two years observations on Dioscoreas in Singapore, the caterpillars of three lepidoptera have attracted attention. They are:—

Theretra nessus, Moore

Loxura atymnus, Horsf. and

Tagiades gana, Butl.

The second is the most injurious.

Theretra nessus is a Sphingid, already recorded as attacking the common yam (*Dioscorea alata*, Linn.). Owing to the large size which the caterpillar attains, the number of leaves consumed is considerable; but as the eggs are laid singly, the injury to a plant is generally restricted to what is required to satisfy the appetite of one individual.

Offered a choice of food-plants of the genus Dioscorea, the caterpillars refused none; but they ate the leaves of *D. alata*, Linn., *D. pyrifolia*, Kunth, *D. bulbifera*, Linn., *D. pentaphylla*, Linn., and of a Philippine ally of the last which is thought to be *D. Cumingii*, Prain and Burkill, in preference to those of *D. aculeata*, Lamk., and *D. triphylla*, Linn. It is known that dioscorine is present in the leaves of the last named; but the surface is covered with small bristly hairs; and it is likely that the hairs deterred to caterpillars from feeding readily more than any dioscorine present.

The moth of *Theretra nessus* is figured in Moore's Lepidoptera of Ceylon, (1882-83), plate 86, and there is a description of it on p. 22 of volume II.

Across the fore wings the moth is 11 cm. The general colour is dull red and olive green above, but below orange. The fore wings are nearly white at the tip, and white on the fore margin; behind this are diagonal belts of olive green, smoky grey and dull salmon. The caterpillar is of a pale green, streaked with white down the back and obliquely on the sides, the streaking ill-defined; and it has two defined white spots forward, which when it has been disturbed and has drawn in its head, have somewhat the position in which eyes might be expected. It attains a length of 14 centimetres (5½ inches). At maturity it spins a cocoon of a rather small amount of silk among leaves, drawing them together; and when it turns into a chrysalis is upwards of 11 cm., long, streaked in various shades between buff and claret.

The caterpillar of *Loxura atymnus* is a green slug-like object which eats the very young parts of the plant. So far it has only been found on *Dioscorea alata*, on *D. anguina* Roxb., and on an imported African yam. The eggs are laid singly, but many to a plant, on the tips of growing shoots, and the caterpillar devours by preference the

upper parts of the just expanding leaves, or less freely the tip of the stem. When a caterpillar on a rapidly growing shoot has found food in a pair of leaves for some days during which growth has carried the other softer parts far beyond; it does not wander up the shoot, but attacks the stem close at hand and eats the surface into small pits, which turn black; at times the shoot may be so much eaten as to break or to die above the place.

The caterpillar attains a length of 2.25 cm., with a maximum width forward of about 7 mm. The body is somewhat flattened towards the tail. The legs are entirely hidden by the overlapping sides, and the head is similarly hidden. The colour of the caterpillar is a rather light leaf-green with a pair of magenta markings, or with two pairs, on the back near the middle, the ground colour rather yellowish-green between them. Towards the head and the tail the green colour darkens a very little. And near to the tail are two retractile processes, withdrawn more often than exserted, very small and white, with papillae.

Ants commonly run over the caterpillars seeking for something that they cannot find. As formic acid is present in the caterpillars of some allied lepidoptera, it might possibly be a smell of this which attracts them; but evidence is lacking.

When the caterpillar is mature, it attaches itself to the stem and pupates, forming a chrysalis buff over the wings and along a broad streak down the back, elsewhere of the brightest green. The tail is very broad.

The butterfly has dark orange wings with a black border, and the hinder are provided with a broadish tail which is pale towards the extremity, and curves out of the plane of the wing. The black border runs from the middle of the anterior rounded edge of the forewing to the posterior angle of the hinder wing. Further the hind wings are slightly suffused with black. Below the wings are of an orange ochre, with a faint line across them parallel to the outer margins. The diameter across the expanded wings is 5 cm. It is figured in Distant's Rhopalocera Malayana (1882-86), plate xxxix., figure 2.

Tagiades gana feeds on the mature leaves of *D. alata*, and has also been observed on *D. cirrhosa*, Lour. It cuts into the leaf until it can fold over a piece of it and so manufactures with a little silk a covering for itself; or sometimes it fastens two leaves together. From within its covering it feeds on the foliage, making a new case as often as may be necessary. It is smooth skinned and narrow behind the head, which is bilobed behind. The chrysalis is hazel coloured, and rests in the last leaf-wrapping that the caterpillar has constructed.

The butterfly which is figured in Distant's Rhopalocera Malayana (1882-86), on plate xxiv, figure 7, is 9 cm. across the wings. These

wings are umber brown above, the hinder pair bluish white in the posterior third.

All three insects are Indian as well as Malayan, and one, if not the others, occurs in China.

I. H. BURKILL.

FRAGMENTS OF MALAYAN GEOGRAPHIC BOTANY.

No. I. Enumeration of Pahang plants collected by the late A. M. Burn Murdoch.

On a journey of inspection down the Pahang river in June, 1913, the late Mr. A. M. Burn Murdoch, took with him a collector from the Botanic Gardens, Singapore, and obtained the species here enumerated.

The collecting began near Temerloh, which is 75 miles in a straight line from the coast, and was continued down the tortuous course of the river to its mouth, whence again northwards, it was carried up the coast to Balok.

Nos. 151-179 came from Temerloh and its neighbourhood. Nos. 180-192 came from places on the first 60 miles of this river's course below Temerloh. Nos. 193-200, and 301-311 came from the neighbourhood of the Chenik river where is a forest reserve. Nos. 312-332 were collected below the Chenik river, chiefly about Kwala Pahang. Near Kuantan, Balok and Beserah were collected Nos. 201-224 and Nos. 333-350.

There is a paper by Mr. H. N. Ridley on the flora of this part of the Peninsula in the Transactions of the Linnean Society of London, 2nd Series, Botany, iii., pp. 267-408, enumerating very many more plants than are here recorded; but nevertheless Mr. Burn Murdoch's bundles add much information towards a knowledge of the distribution of plants in the Peninsula.

There is a further brief notice of the flora of the lower part of the Pahang river in the Journal of the Straits Branch of the Royal Asiatic Society, part 25 (1894) pp. 33-37.

Mr. Ridley has kindly described the novelties of the collection in the Journal of the Straits Branch of the Royal Asiatic Society, No. 68 (1915), pp. 12-14.

Here after each name an indication is given of the dispersal which that plant has in the Peninsula: and unfortunatey the scantiness of our knowledge of the flora of the Eastern side is made evident in it.

Unona longiflora, Roxb. Chenik, No. 197.
Distr: A northern plant extending southwards, at any rate all down the west side, to Singapore, now first obtained on the east side.

Polyalthea Teysmanni, King. Temerloh, No. 154.
Distr: Selangor and Pahang, southwards.

Nymphaea stellata, Willd. Semantan road, No. 156: Tasek Chenik, No. 308.
Distr: Here and there in the Peninsula; but hardly recorded from the southern parts.

Crataeva macrocarpa, Kurz. Tasek Chenik, No. 302.
Distr: From the north to Malacca on the west coast and in Pahang.

Pittosporum ferrugineum, Ait. Kwala Pahang, No. 326.
Distr: Probably throughout the Peninsula, though at present unknown from the east coast except at Kwala Pahang.

Xanthophyllum glaucum, Wall. Tasek Chenik, No. 307.
Distr: From the north to Perak and Pahang.

Sida cordifolia, Linn. Kwala Pahang, No. 332.
Distr: In places chiefly near the coast as a weed.

Elaeocarpus paniculata, Wall. Temerloh, No. 162.
Distr: Apparently throughout the Peninsula.

Elaeocarpus stipularis, Blume. Pahang river between Lubok Paku and Binking, No. 189.
Distr: Apparently throughout the Peninsula.

Hiptage madhablota, Gaertn. Kuantan, No. 219.
Distr: From the north southwards to Kuala Lumpur and the Pahang river.

Aglaia cordata, Hiern. Kwala Bera, below Temerloh, No. 173.
Distr: From Perak to Singapore on the west side; from the east now for the first time collected.

Chailletia setosa, King. Balok, No. 214.
Distr: Perak to Malacca, and on the Pahang river.

Cansjera Rheedei, Gmel., var. Tanjong Tembeling near Kuantan, No. 222.
Distr: Mangrove swamps round the coast.

Euonymus javanicus, Blume. Kwala Pahang, No. 320.
Distr: Apparently general in the Peninsula.

Trigonachras acuta, Radlk. Kuantan, No. 3 7.
Distr: Singapore, Pahang and Malacca.

Allophyllus Cobbe, Blume. Chenik reserve, No. 301.
Distr: A very common plant in the Peninsula.

Jagera speciosa, Blume. Chenik, No. 199.
Distr: Selangor and Pahang.

Dodonaea viscosa, Jacq. Kwala Pahang, No. 328.
Distr: Around the Peninsula at rather widely spaced places.

Desmodium polycarpum, D.C. Kuantan, No. 335; also var., *ovatifolium*, Wall. Kuantan, No. 334.
Distr: Common throughout the Peninsula.

Desmodium umbellatum, D.C. Basrah, No. 202.
Distr: All round the coasts of the Peninsula.

Uraria crinita, Desv. Binking, No. 192.
Distr: Very general in the Peninsula.

Pueraria phaseoloides, Benth. Pulau Rusa, No. 315.
Distr: From the north, southwards to Negri Sembilan.

Canavalia lineata, D.C. Karang river at Basrah, No. 217.
Distr: Around the coasts.

Canavalia obtusifolia, D.C. Semantan road, No. 159.
Distr: Around the coasts and up the Pahang river.

Dunbaria Scortechinii, Prain. Pulau Rusa, No. 314.
Distr: Southern Siam to Perak, and the Pahang river.

Flemingia congesta, Roxb. Pulau Rusa, No. 316.
Distr: From the north to Malacca and the Pahang river.

Derris sinuata, Thwaites. Kwala Pahang, No. 331.
Distr: Around the coasts of the Peninsula.

Cassia nodosa, Ham. Temerloh, No. 153.
Distr: From the north to Malacca and the Pahang river.

Cassia siamea, Lamk. Kwala Bera, below Temerloh, No. 180.
Distr: From the north to Malacca and the Pahang river.

Cassia mimosoides, Linn. Tasek Chenik, No. 312.
Distr: Throughout the Peninsula.

Bauhinia integrifolia, Roxb. Lubok Paku, No. 182.
Distr: Throughout the Peninsula.

Saraca triandra, Baker. Foot of Bukit Basrah, without number.
Distr: From the north, southwards to Malacca and the Pahang river.

Acacia pennata, Willd. Binking, No. 191.
Distr: From the north to Malacca and the Pahang river.

Parinarium nitidum, Hook. f. Kwala Pahang, No. 325.
Distr: Setul to Malacca, in Singapore and on the Pahang river.

Carallia lucida, Roxb. Pahang river between Lubok Paku and Binking, No. 188.
Distr: All down the west side of the Peninsula, and now first collected on the east side.

Combretum ?stenopetalum, Heurck and Muell. Arg. Pahang river between Lubok Paku and Binking, No. 190.
Distr: Probably an addition to the known flora of the Peninsula.

Barringtonia spicata, Blume. Chenik, No. 195.
Distr: Trang to Malacca on the west side, Pahang on the east side.

Barringtonia fusiformis, King. Chenik, No. 198.
Distr: Perak and Selangor on the west side, Pahang on the east side.

Pternandra coerulescens, Jack. Chenik, No. 196.
Distr; General through the Peninsula.

Memecylon dichotomum, C. B. Clarke. Temerloh, No. 164.
Distr: Kedah to Malacca on the west side, on the east side along the Pahang river, whence it has been brought twice before.

Sarcocephalus subditus, Miq. Pahang river between Lubok Paku and Binking, No. 185.
Distr: From Perak, southwards to Singapore, and on the Pahang river.

Sarcocephalus Junghuhnii, Miq. Kuantan, on Bukit Galing, No. 340.
Distr: Known hitherto from the western side of the Peninsula and from Singapore, but its wide distribution outside made probable its occurence on the eastern side.

Mussaenda mutabilis, Hemsl. Vern.—Balik Adap as in Sungei Ujong. Temerloh, No. 170.
Distr: Known to occur all down the east of the Peninsula and in Pahang.

Gardenia carinata, Wall. Vern.—Laca Hutan. Temerloh, No. 169.
Distr: Penang and Perak to Malacca; now also obtained in central Pahang; recorded as obtained by Murton in Singapore (? cultivated only).

Gardenia tubifera, Wall. Bukit Berhala, Tasek Chenik, No. 304.
Distr: General throughout the Peninsula.

Gardenia tentaculata, Hook. f. Tasek Chenik, No. 311.
Distr: Apparently general throughout the Peninsula from Penang, Province Wellesley, and Tringganu southwards. It has been obtained before twice on the Pahang river.

Diplospora ?velutina, King and Gamble. Bukit Galing, Kuantan, No. 344.
Distr: Hitherto recorded for Perak only.

Canthium didymum, Roxb. Pulau Lantai, No. 306.
Distr: General throughout the Peninsula.

Canthium parvifolium, Roxb. Bukit Ubi, Kuantan, No. 349.
Distr: General throughout the Peninsula.

Ixora stricta, Roxb. Temerloh, No. 158; Kwala Pahang No. 319.
Distr: General throughout the Peninsula.

Ixora humilis, King and Gamble. Balok, on Bukit Kapis, No. 215.
Distr: Penang, Temerloh, Perak and Selangor, and on the east coast in Pahang.

Ixora cf. *concinna*, R. Br. Chenik reserve, No. 200.
Distr: *I. concinna* occurs generally through the Peninsula.

Pavetta humilis, Hook., f. Balok, on Bukit Kapis at 300 ft., No. 211.
Distr: From the west coast at Malacca to the east coast at Balok.

Prismatomeris albidiflora, Thwaites. Temerloh, No. 179.
Distr: General throughout the Peninsula.

Vernonia arborea, Buch.-Ham. Bukit Galing at Kuantan, No. 339.
Distr: General along the west side of the Peninsula, and probably also along the east side; but so far only collected on the Pahang river and at Kuantan.

Plumbago zeylanica, Linn. Semantan road, No. 157.
Distr: In most parts of Peninsula apparently.

Ardisia crenata, Roth. Balok, No. 209; Kwala Pahang, No. 330.
Distr: General throughout the Peninsula.

Ardisia littoralis, Andr. Kwala Pahang, No. 329.
Distr: General around the Peninsula; but not necessarily on the coast.

Sideroxylon ferrugineum, Hook. and Arn. Kwala Pahang, No. 317.
Distr: All down the western side of the Peninsula; on the eastern side only known from the mouth of the Pahang river and Pulau Tiuman.

Symplocos Curtisii, Oliv. Balok, on Bukit Kapis, No. 216.
Distr: Occurs in Penang, Perak, Selangor, Negri Sembilan and Pahang.

Symplocos spicata, Roxb. Pulau Lantai, No. 305.
Distr: From the north to Malacca and in Pahang.

Jasminum bifarium, Wall. Pahang river between Lubok Paku and Binking, No. 184.
Distr: All down the west side of the Peninsula, and general apparently in Pahang (and probably down the east side).

Ervatamia malaccensis, King and Gamble. Temerloh, without number.
Distr: All down the west side of the Peninsula; now first collected on the eastern side.

Parsonsia spiralis, Wall. Balok, No. 205.
Distr: Down the west coast of the Peninsula; now first collected on the eastern side.

Aganosma marginata, G. Don. Pahang river between Lubok Paku and Binking, No. 187.
Distr.: Apparently in all parts of the Peninsula.

Tylophora sp., very near to *T. asthmatica*, W. & A. Kwala Pahang, No. 327.
Distr: This species of Tylophora occurs from Tringganu to Kwala Pahang.

Hoya latifolia, G. Don. Chenik, No. 194.
Distr: Pahang, Johore and Singapore.

Fagraea fragrans, Roxb. Pulau Berhala, No. 303.
Distr: In several parts of the Peninsula, chiefly near the coast (vide Burn Murdoch, Trees and timbers of the Malay Peninsula, ii., 1912, p. 3).

Norrisia malaccensis, Gardn. Bukit Galing at Kuantan, No. 348.
Distr: In Perak and Malacca; and now also known from Pahang.

Ipomoea pes-caprae, Roth. Karang river at Basrah, No. 218.
Distr: Probably all round the coasts.

Ipomoea littoralis, Boiss. Tanjong Tembeling near Kuantan, No. 221.
Distr: On the coast near Malacca and near Kwala Pahang.

Merremia hastata, Hallier f. Balok, No. 207.
Distr: General through the Peninsula.

Cordia premnifolia, Ridl., in Journal R. Asiatic Society, Straits Branch, No. 68, p. 12. Pahang river between Lubok Paku and Binking, No. 186.
Distr: An addition to the Malay Flora, known from Kwala Lipis and the Pahang river.

Didymocarpus crinita, Jack. Temerloh, No. 165.
Distr: Through the Peninsula.

Justicia ptychostoma, Nees. Temerloh, No. 167 and 168.
Distr: From the north southwards to Negri Sembilan and Pahang.

Justicia remotiflora, Ridl., in Journal R. Asiatic Society, Straits Branch, No. 68, p. 12. Temerloh, No. 175.
Distr.: An addition to the known Malay Flora.

Vitex trifolia, Linn. Kwala Pahang, No. 313.
Distr: On the coast at Penang, Malacca, Singapore and Pahang.

Clerodendron neriifolium, Wall. Tanjong Api at Kuantan, No. 220.
Distr: On the coast round the Peninsula.

Nepenthes ampullaria, Jack. Kuantan, No. 338.
Distr: Throughout the Peninsula, south of Penang and Perak.

Alseodaphne peduncularis, Hook. f. Temerloh, No. 166.
Distr: From Penang and Perak to Negri Sembilan on the west side; now also in Pahang.

Litsea johorensis, Gamble. West of Temerloh, No. 171.
Distr: Johore, and now also known from Pahang.

Litsea amara, Blume. Temerloh, No. 161.
Distr: General throughout the Peninsula.

Neolitsea zeylanica, Merrill. Kwala Pahang, No. 321.
Distr: Down the east side to Singapore; but from the west side only as yet collected in Pahang.

Loranthus grandifrons, King. Temerloh, No. 151.
Distr: Down the east side to Malacca, and in Pahang.

Henslowia varians, Blume. Kwala Pahang, No. 318.
Distr: Throughout the Peninsula.

Glochidion littorale, Blume. Sungei Balok, No. 204.
Distr: Down the east coast to Singapore and in Pahang.

Glochidion laevigatum, Hook. f. Sungei Balok, No. 206.
Distr: Penang to Singapore, and in Pahang.

Ostodes macroplylla, Benth. & Hook. f., var. Semantan road station, No. 160.
Distr: Perak, Malacca, Singapore and Pahang.

Mallotus sp. Very like some Philippine specimeus of *M. ricinoides*, Muell. Arg. Male flowers only. Basrah, No. 201.

Thismia racemosa, Ridl., in Journal R. Asiatic Society, Straits Branch, No. 68, p. 13. Six miles south east of Temerloh, No. 178.
An addition to the known Malay Flora.

Thrixspermum Calceolus, Reichb. f. Tanjong Tembeling at Kuantan, without number.
Distr: From Penang to Singapore, and in Pahang.

Renanthera alba, Ridl. Balok, No. 208.
Distr: Singapore and Pahang.

Tropidia squamata, Blume. Bukit Galing near Kuantan, No. 345.
Distr: From Kedah to Singapore on the west side; in Pahang on the east side.

Gastrochilus plicatus, Ridl. Balok, Bukit Kapis, No. 212.
Distr: Known from the central range in Perak, from Kuantan, and now from the Pahang coast.

Gastrochilus biloba, Ridl. Balok, Bukit Kapis, No. 210.
Distr: Known from the central range in Perak, Pahang and Selangor; and now from the Pahang coast.

Amomum ochreum, Ridl. Bukit Galing at Kuantan, No. 347.
Distr: Selangor and Pahang.

Amomum uliginosum, Koen. Bukit Galing at Kuantan, No. 342.
Distr: From Penang and Perak to Johore, and in Pahang.

Hornstedtia megacheilos, Griff. Bukit Galing at Kuantan, No. 341.
Distr: From Penang and Perak to Singapore, on the west side; also in Pahang.

Donax arundinastrum, Lam.; (Clinogyne grandis, *Benth.*), Kwala Bera, below Temerloh, No. 181.
Distr: Throughout the Peninsula.

Xyris anceps, Lam. Kuantan, No. 333.
Distr: In most parts of the Peninsula.

Iguanura geonomaeformis, Mart. Kwala Bera, below Temerloh, No. 174.
Distr: From Perak to Singapore, on the west side; and also in Pahang.

Calamus Guruba, Buch.-Ham. Chenik, No. 193.
Distr: From the north southwards to Perak and Pahang.

Amorphophallus sp. Bukit Galing at Kuantan, No. 343.

Homalonema rostratum, Griff. Semantan road, No. 155.
Distr: Selangor and Pahang to Johore.

Cryptocoryne cordata, Griff. Balok, on Bukit Kapis, No. 213.
Distr: Malacca and Pahang.

Eriocaulon sexangulare, Linn. Tasek Chenik, No. 310.
Distr: Penang, Negri Sembilan, Malacca, Pahang, Johore, Singapore, and probably wider.

Lepironia mucronata, Rich. Tasek Chenik, No. 309.
Distr: Dindings to Singapore, on the west side; and on the east in Pahang.

Rhynchospora aurea, Vahl. Kuantan, No. 336.
Distr: Throughout the Peninsula.

Andropogon Wightianus, Steud. Kwala Pahang, No. 323.
Distr: Within the Peninsula only known from the Pahang coast.

Thuarea sarmentosa, Pers. Balok, No. 203.
Distr: On the coasts round the Peninsula.

Spinifex squarrosus, Linn. Kwala Pahang, No. 324.
Distr: On the east coast in Tringganu and Pahang; and on the west coast in northern Johore.

Aspidium singaporeanum, Baker. Six miles south-east of Temerloh, No. 177.
Distr: Throughout the Peninsula.

Diplazium speciosum, Mett. Temerloh, No. 176.
Distr: Apparently throughout the Peninsula.

Asplenium macrophyllum, Swartz. Tanjong Tembeling at Kuantan, No. 223.

Distr: All through the Peninsula, on the western side; from the eastern side only obtained as yet in Pahang.

Lycopodium Phlegmaria, Linn. Tanjong Tembeling at Kuantan, No. 224.

Distr: Throughout the Peninsula.

I. H. BURKILL.

ORCHID NOTES.

So little is known of the botany of eastern Johore that it is of interest to record the receipt from Mr. St. V. B. Down, of the following three orchids collected by him on the Sedili river near Dohol:—

Eria vestita, Lindl.

Eria velutina, Lindl., 30 feet above the river on a *Lagerstroemia indica*, associated with Drynaria.

Dendrobium Serra, Lindl.

Dendrobium crumenatum, Sw.—the Pigeon-orchid.

From Mr. F. J. Hallifax, President of the Municipal Commission, Singapore, the Gardens have received specimens of a salmon flowered *Dendrobium crumenatum*, Sw. The plant grows on Goodwood Hill, Singapore, uncultivated, in Mr. Hallifax's garden. Its stems are of a bright chestnut colour.

Thecostele secunda, Ridl.

Thecostele secunda, Ridl., flowered in the Botanic Garden, in October, 1914, producing four downwardly directed (rigid, not pendilous) racemes with respectively 6, 7, 11 and 17 horizontal flowers. It flowered again in April, 1915. The plant was brought from Sarawak, by Mr. J. W. Anderson, in 1912. Its leaves measure 9 by 1½ inches.

A description of the colour of the flower is desirable. The interior sepal is honey-coloured with a slight claret flush outside near the tip and a light claret median line within in the lower half; the lateral sepals are similarly coloured but the line within is obscure. The lateral petals are honey-coloured becoming paler towards the tip, the margin below this pale part and the median line within being claret. The lip has on the median lobe a whitish ground with a well defined claret V in the centre and ill defined lateral Vs on each side of it merged into it at the contiguous extremities. These are formed by claret coloured hair; a small yellowish honey-coloured spot lies above the central V with a claret dot on each side of it,

and beyond are three claret dots, the erect lateral being just under the two crests of the lip; the lateral lobes are liver coloured on both sides with a white border and a patch of claret coloured hair inside the fold at the base.

The column has lines of pale claret below and is a deep dull maroon above with the stigma greenish white, the anther wall pale claret and the side lobes tipped as if with grey wax.

The surface of the column foot over the nectary, directed to the inside of the flower, is white: at the head of its cavity is an orange coloured nectary of considerable size which secretes abundant honey.

Every bract, before the flowers are mature, has a nectary at the centre outside which secretes a tiny drop of clear honey. When the buds are young the apex of the axis bearing them bends up straightening itself as they approach maturity.

Five species of Thecostele are known, occurring from Burma to Borneo and Java: and the road to their honey is so crooked that it would be most interesting to ascertain what insects visit the flowers.

Microstylis congesta, Reichb. f.

Among the orchids brought back by Mr. J. C. Moulton from the slopes of mount Kinabalu, were living specimens of *Microstylis congesta,* from which the following notes have been made: for even thought the orchid is well known in herbaria, a description from life of the flowers is worth giving.

Of the several plants of the orchid sent to the Botanic Gardens the largest bore seven full sized bright green leaves.

Before opening the buds ascend very slightly from the horizontal; but when the flower has opened the ovary curves slightly so that the flower faces a little down from the horizontal. During flowering the ovary straightens itself again, and after flowering it ascends so as to lie as close to the axis as possible. The bracts are lanceolate, very acuminate, and become strongly reflexed early, remaining so; they are pale green.

The sepals are green with a tinge of purple which increases through flowering. The lateral sepals curve round from behind the labellum towards one another but do not meet by about 1½ mm.; they are 4½ mm. long and when flattened 2 mm. broad; but owing to the way in which they are folded back along their midrib their edges are not more than 1½ mm. apart. The dorsal sepal (the sepal which would be dorsal if the ovary were twisted) is longer and narrower that the lateral sepals; it is curved forwards so that its point comes to the front of the flower just under and almost from between tips of the lateral sepals; length 5 mm. breadth 1½ mm.: These three sepals make a landing stage for visiting insects.

The lateral petals are similar in colour to the sepals. They are curved a little—less than the lateral sepals—and project outside them; length 3½ mm., breadth 1 mm. or a little more.

The lip is emerald green with malachite green at the lateral borders. Its centre forms a shallow flat bottomed recess. The borders of this recess are thickened particularly below and less so at the sides.

The sides of the lip are parallel and drawn forward on either side of the column, but they end rounded below and not in auricles. The apex has three teeth, of which the central is bent back on the limb through about 40 degrees. From base to apex of this tooth, the lip, measured outside, is 3 mm. long, but inside it is so attached to the column that there is less than 2 mm. free. If the lip be flattened it is found to be 2½ mm. across.

The column is emerald green. The anther wall after the flower opens shrivls and frees the pollinia upwards. It seems probable that pollen can reach the stigma without the intervention of insects. But the parts are so small that it is very difficult to ascertain what usually happens.

After flowering a purple line appears on the ovary down the dorsal face from top to bottom, and two smaller fainter lines appear on the ridges on either side: these ridges are slightly frilled.

In the Annals of the Royal Botanic Gardens, Calcutta, viii., (1898) on plate 23 is figured the Sikkim form of this species. The flowers of which are "red or occasionally yellow" (p. 20).

I. H. BURKILL.

THE SINGAPORE PRICKLY-PEAR.

The Prickly pear which may he seen near the coast about Tanjong Katong, on various roofs in Singapore town, sometimes in Chinese gardens and often in pots in Chinese houses, is *Opuntia monacantha*, Haw., and not *Opuntia Dillenii*, Haw., as recorded.

Its home is in south-eastern Brazil, along the coastal districts; in which place it must have attracted the attention of early voyagers, for there is a figure sufficiently accurately representing it in Lobel's Icones which was published in A. D. 1591.

It was certainly in english Winter-gardens about 1700; and long before 1790, at which Sate the records for India begin, it was taken to Southern India and Bengal so that in 1790 it had already become widely distributed from Madras to Calcutta; there is reason to believe that it was in Cochin-China also at the same period. The shoots were supplied to ships for a vegetable because, although

not very appetising, anything was valuable that would keep green and could be used to ward off the dreaded scurvy. It is probable that its distribution to the East was due to this use.

Its home in the coastal region of south-eastern Brazil has a moist climate; and the countries, which are its new homes, have like conditions. It has recently been recorded by Dr. H. Johnstone and Mr. Henry Tryon in the Report of the Queensland Prickly-Pear Travelling Commission, to exists in Southern France (as a rare plant), in the island of Teneriffe, in the coastal regions of South Africa from the Cape peninsula to East London, in Natal, at Pretoria and Pietershurg in the Transvaal, at Zanzibar, Beira and Lorenzo Marques in East Africa, in Queensland, New South Wales, Victoria and South Australia, as well as in the sub-Himalayan tracts, Assam, Bengal, the eastern parts of the Central Provinces of India, Madras, Ceylon and Burma.

Opuntia monacantha is one of the very few Prickly-pears which withstand the moisture of Singapore and are not difficult to cultivate.

I. H. BURKILL.

A NEST OF LIVING DRYMOGLOSSUM PILOSELLOIDES.

It is recorded that birds making nests in Europe sometimes distribute herbs, because seed accidentally gets enmeshed in the material interwoven (Willis and Burkill in *Proceedings of the Cambridge Philosophical Society,* viii.; 1893, p. 86); but the use of a living fern in the East is probably unrecorded.

In clearing away a thicket in the Botanic Gardens a nest of the Merebah (*Pycnonotus analis*) was found in the crown of a tree fern, having a foundation of dead leaves, a lining of Arenga palm fibre, and a wrapping of living and leaf-bearing rhizomes of the common little epiphytic fern *Drymoglossum piloselloides,* Presl, which by this use had obtained a new coign of vantage.

Ridley in the Journal of the Royal Asiatic Society No. 31, 1898, p. 84, writes of this bird in the Botanic Gardens making nests "of bents and roots."

I. H. BURKILL.

KENARI SEEDS, CANARIUM RUFUM.

Botanic Gardens, Singapore, 11th June, 1914.

SIR,

In my letter dated 31st January, 1914, under which the nuts of *Canarium commune* were forwarded to you, I promised to send those of *Canarium rufum*, when ripe.

I have now the honour to advise the despatch to you of 368 of the nuts of the latter species.

I am, Sir,
Your obedient servant,
(Signed) I. H. BURKILL,
Director of Gardens, S. S.

The Director,
Imperial Institute,
London,

Imperial Institute, London, S. W.
21st August, 1914.

Sir,

I have the honour to enclose a report on a sample of *Canarium rufum* seeds which was forwarded to the Imperial Institute by the Director of the Botanic Gardens at Singapore with letter dated 11th June, 1914.

I have etc., (Signed)—ERNEST GOULDING,
for the Director.

His Excellency The Governor,
Straits Settlements.

Date, 21st August, 1914.

Imperial Institute No. 54063. Reference.

Letter dated 11th June, 1914, from the Director of the Botanic Gardens at Singapore.

Weight, 10½ lbs.

Number or mark, and weight of sample. Description.

The sample consisted of nuts having a brown, tough outer coat of shrunken appearance, about ⅛ inch thick, which in a few cases had partially rotted away. The outer coat enclosed a three-sided, hard nut, tapering to a point at each end, of a brown colour, and about 1¾ inches long and ¾ inch thick. Embedded in the woody shell were three slender kernels about 1 inch long, and from ⅛ to ¼ inch thick having a brown seed-coat. The kernels were white, oily and had a pleasant taste.

The nuts consisted of husk 95.3 per cent. and kernel, 4.7 per cent (seed coat 1.6 per cent, interior, 3.1 per cent). The kernels were analysed with the following results:—

Results of examination of the kernels after removal of the seed coat.

Moisture	per cent. ...	...	3.9
Crude proteins ...	„ „ ...	...	16.4
Consisting of			
True proteins ...	„ „ ...	15.5	
Other nitrogenous substance ...	„ „ ...	0.9	
Fat	„ „ ...	...	70.5
Starch, &c. (by difference)	„ „ ...	...	4.2
Fibre	„ „ ...	...	trace
Ash	„ „ ...	...	5.0
			100.0

Nutritive value.

Nutrient ratio ... ... I : 10.1

(The ratio between the percentage of crude proteins and the sum of percentage of starch and fat, the latter being first covered into its starch equivalent).

Food units 221.4

(The total obtained by adding the percentage of starch to 2.5 times the sum of the percentages of fat and crude proteins). ...

Commercial valuation and remarks.

These kernels have a very high food value, equal to to that of *Canarium commune* kernels, which they resemble in taste and appearance.

The remarks made with reference to the possibility of profitably exporting *Canarium commune* nuts (see Imperial Institute Report dated 7th April, 1014), also apply to the *Canarium rufum* nut. The higher percentage of husk in the present sample is, to certain extent, due to the presence of the outer coat of the fruit which, in the case of the *Canarium commune* nuts, had been removed before despatch.

ONE HUNDRED MILES FOR BLOW-PIPE POISON.

Mr. J. B. Reid of the Soengei Cerpa Estates, Kwala, East Coast of Sumatra, states in a letter on the subject of the Upas tree, *Antiaris toxicaria*, that during the last intertribal war of the interior, men from the mountains came down to Kwala, a distance of 100 miles and more, to collect the juice for the poisoning of their blow-pipe darts.

RAINFALL

at the Director's house, Botanic Gardens, Singapore, during the first half of the year 1914.

Readings taken always at 8 a.m. and credited to the date in which the twenty-four hours begin.

Day.	January.	February.	March.	April.	May.	June.
1	0.48	0.37	...	0.06	0.02	0.11
2	0.64	1.86	...	0.04	0.01	...
3	4.13	0.05	0.22	0.05	0.05	...
4	5.27	1.14	0.05	0.03	0.62	...
5	0.57	0.02	1.31	0.01	2.32	...
6	1.24	0.01	...	0.05	Trace	...
7	0.22	0.07	...	1.46	0.20	0.31
8	...	...	...	0.54	...	0.27
9	0.01	...	0.52	2.57	0.79	0.06
10	...	0.02	Trace	0.95	Trace	0.94
11	...	0.01	0.01	0.38	...	0.05
12	0.18	0.38	...	...	...	2.11
13	Trace	...	0.51	5.42	...	0.01
14	...	...	...	0.04	0.03	0.18
15	...	...	0.35	...	0.03	0.10
16	1.23	...	0.56	Trace	0.02	0.14
17	...	...	1.38	2.58	0.02	...
18	0.03	...	0.25	...	...	...
19	2.54	...	Trace	0 02	...	0.65
20	1.68	...	0.19	...	0.14	0.04
21	...	...	0.56	...	0.15	...
22	Trace	...	1.58	...	...	...
23	1.11	...	...	1.62	0.08	...
24	2 73	...	...	0.02	...	...
25	0.52	...	...	...	...	2.46
26	0.97	...	0.04	0.10	0.34	0.01
27	0.27	...	...	...	...	0.26
28	0 01	...	...	0.01	0.09	0.24
29	0.33	—	0.54	0.25	0.06	0.16
30	1.23	—	1.71	0.40	...	0.48
31	0.01	—	0.18	—	...	—
	25 40	3.93	9.96	16.60	4.97	8 58

RAINFALL

at the Director's house, Botanic Gardens, Singapore, during the second half of the year 1914.

Date.	July.	August.	September.	October.	November.	December.
1	0.16	...	..	...	...	Trace
2	1.05	...	0.03	...	0.01	0.28
3	Trace	0.11	...	1.14	0.01	Trace
4	...	...	...	0.12	...	0.02
5	...	...	0.04	...	0.03	...
6	...	...	1.47	...	0.01	...
7	...	...	0.17	...	0.14	3.09
8	...	0.31	0.37	...	...	0.56
9	...	...	0.28	...	0.42	Trace
10	...	0.63	...	...	0.58	0.12
11	...	...	0.03	Trace	0.25	0.23
12	1.02	...	...	...	Trace	...
13	...	...	...	...	...	0.43
14	...	...	...	...	0.11	0.02
15	...	0.02	0.32	...	0.41	...
16	...	...	0.02	...	...	0.03
17	0.24	...	0.38	0.07	...	...
18	0.09	...	0.02	0.03	...	1.02
19	0.35	Trace	0.01	1.56	0.14	1.47
20	0.58	Trace	...	0.83	0.02	0.08
21	0.09	...	...	...	0.03	0.02
22	...	Trace	...	..	1 59	0.03
23	...	0.07	...	Trace	0.64	0.41
24	..	...	...	0.03	0.89	0.14
25	1.10	...	...	...	1.72	0.12
26	0.01	...	...	...	0.02	0.58
27	...	...	...	0.03	0.17	0.01
28	Trace	...	...	0.01	0.62	0.02
29	0.02	..	...	0.14	0.05	0.72
30	...	...	...	0.01	...	0.14
31	...	...	—	0.11	—	...
	4.71	1.14	3.14	4.08	7.86	8.54

RAINFALL

at the head of the Waterfall Gardens, Penang, during the first half of the year, 1914.

Readings taken at 8 a.m. and credited to the date in which the twenty-four hours begin.

Date.	January.	February.	March.	April.	May.	June.
	Inches.	Inches.	Inches.	Inches.	Inches.	Inches.
1	...	..	...	...	...	...
2	...	1.92	...	0.13	0.52	...
3	...	0.05	...	0.98	1 00	...
4	...	...	...	1.98	0.27	...
5	...	0·07	...	...	0.04	...
6	...	...	...	0.16	1.16	...
7	1.03	...	0.03	0.95	0 75	...
8	0.01	...	...	...	1.75	1.65
9	...	...	0.23	3.10	0.77	...
10	...	0.10	...	...	0.02	3.35
11	...	...	...	1.03	0.20	2.15
12	...	0.06	1.21	0.08	...	...
13	0.18	..	0.32	0.30	...	...
14	0.20	...	1.30	...	...	0.37
15	...	...	0.65	...	...	0.50
16	...	...	...	...	...	...
17	...	...	...	...	...	0·06
18	...	...	1.17	0.38	...	...
19	0.09	...	...	...	0.22	0 73
20	...	...	...	...	1.08	0.03
21	...	0.03	...	...	0.08	...
22	...	...	...	...	...	...
23	...	...	...	0.02	3.20	...
24	...	2.70	1.35	0.05	1.23	...
25	0.01	0.07	...	0.03	...	...
26	0.07	...	...	0.02	...	...
27	0.26	...	...	...	...	...
28	0.04	...	...	...	...	0.39
29	...	—	...	0.02	...	0.06
30	...	—	...	1.22	...	0.32
31	...	—	0.03	—	0.14	—
	1.89	5.00	6.29	10.45	12.43	9.61

RAINFALL

at the head of the Waterfall gardens, Penang, during the second half of the year 1914.

Date.	July.	August.	September.	October.	November.	December.
	Inches.	Inches.	Inches.	Inches.	Inches.	Inches.
1	0.80	0.38	0.10	0.27	..	...
2	0.79	0.02	0.89	...	...	0.91
3	....	0.04	1.52	0.21	0.20	0.39
4	...	0.07	1 74	0.08	0.19	0.12
5	...	0.46	0.36	0.07	0.02	0.01
6	...	...	0.61	0.15	...	...
7	0.14	0.26	1.15	0.10	...	1.14
8	...	0.29	0.26	1.25	0.17	0.20
9	...	...	0.44	...	0.33	0.01
10	...	0.50	0.15	...	0.44	0.04
11	...	...	2.47	0.65	0.04	0.69
12	...	...	...	...	0.19	2.05
13	...	0.20	0.29	0.18	0.24	0.23
14	...	...	...	...	2.85	0.36
15	0.20	1.15	...	1.54	0.86	0.14
16	1.02	...	0.05	0.77	0.01	3.28
17	....	0.02	1.62	0.56	0.21	....
18	...	...	0.97	0.03	2.18	0.62
19	...	...	1.08	0.58	0.05	...
20	...	...	0.18	1.78	0.07	0.06
21	...	...	...	0.12	0.11	0.04
22	...	0.12	...	0.15	0.11	0.03
23	...	...	...	0.81	0.71	0.03
24	2.40	...	...	0.33	...	...
25	0.83	...	...	0.16	0.55	...
26	...	...	0.06	0.21	0.14	0.24
27	...	...	0.78	1.05	0.41	0.73
28	...	...	0.16	0.54	...	...
29	0.07	...	0.35	1.15	0.90	...
30	...	...	4.60	0.73	0.02	0.31
31	...	...	—	0.52	—	...
	6.25	3.51	19.83	13.99	11.00	11.63

Registered by the Municipality of George Town, Penang.

SUMMARY OF RAINFALL, 1914.

	SINGAPORE.			PENANG.		
	No of rainy days.	Amount of rain in inches.	Longest Spell without rain.	No. of rainy days.	Amount of rain in inches.	Longest Spell without rain.
January - -	24	25.40	2 days.	9	1.89	6 days
February -	10	3.93	18	8	5.00	9
March - -	19	9.96		9	6.29	
April - -	22	16.60	3	16	10.45	4
May - -	19	4.97	3	16	12.43	7
June - -	19	8 58	5	11	9.61	7 (twice)
July - -	13	4.71	8	8	6.25	7 (twice)
August - -	8	1.14	9	12	3.51	9
September -	14	3.14	13	22	19.83	5
October - -	12	4.08		27	13.99	2
November -	22	7.86	3	24	11.00	2
December -	25	9.54	2	22	11.63	2
Total	207	99.91	...	184	111.88	...

Greatest amount in 24 hours. ...	5.42	4.60
„ „ 48 „ ...	9.40	4.95
„ „ 72 „ ...	10.04	5.50
Excessively rainy periods, more than 5.00 having fallen in 72 hours.	2 (Jan. & April)	1 (September).
No. of days when condition existed. -	7	2
Periods of Comparative drought, less than 0.02 having fallen in 120 hours.	4	15 (All months Jan., to Sept. except April).
No. of days when the condition existed. - - -	32	39

CADAMUSTUS TYPICUS—A MINOR COCONUT PEST.

In August last, Mr. J. H. George of the Dindings-Selama Coconut Company, sent to the Botanic Gardens specimens of a "white fly" found feeding in numbers on the juices of coconut leaves at Matang Kubu in the Dindings. This insect was sent to the Imperial Bureau of Entomology, at the British Museum of Natural History and a reply received from Mr. G. A. K. Marshall, the Director, to the effect that the insect is "*Cadamustus typicus*. Distant, which was originally described from Ceylon, where it was found to attack Cardamons and Bananas." Mr. Marshall adds that it has recently been received from the Philippine islands.

Cadamustus typicus is a Tingid fly of small size with the wings beautifully laced and the body curiously shaped.

A VERY DESTRUCTIVE FLASH OF LIGHTNING.

In the night of January 10th—11th, 1914, a grove of coconuts on the coast near Bedok, east of Singapore, was struck by lightning, and the number of trees which died at once or slowly over the months which followed amounted to one hundred and four.

The case in recorded on account of the extent of the damage, and of the fact that the cause of the death of the trees is in this case indisputable. This usually is not the case when a malay ascribes the death of a coconut palm to lightning.

I. H. BURKILL.

BORROWINGS FROM NEW BOOKS.

Culture et Exploitation du Caoutchouc au Brésil, by O. Labroy and V. Cayla, Paris, 1913, pp. 1-233.

This book is a report to the Government of Brazil upon the conditions under which rubber is produced in that country at present and the existing facilitities for planting agriculturally viewed. It does not cover the whole ground of rubber-production in Brazil, but for certain regions only; and much of the book is intended to teach the adoption of planting as practiced in Malaya. But there are many interesting observations scattered through its pages, some of real importance to Malaya. The authors (p. 30) say that *Hevea brasiliensis* shows considerable variability in the Amazon basin

observable in the colour of the bark, its corkiness, and its thickness, the colour, shape and size of the leaves, the number of glands on the petiole, the time when fruiting begins, the number of seeds in the fruit, their shape, size and colour, and lastly of the greatest importance in the amount of latex. On p. 63 the authors recommend the collection of seeds from wild trees found to yield well; from p. 42 forward the way in which the Brazilian seringueiro taps is described, the conclusion being reached that the better "to avoid damage to state property resulting from bad tapping, it will suffice to increase the control of the work of the seringueiro instead of as Akers advised enforcing the disuse of his tapping axe in favour of a tapping implement more modern but strange among the Amazon workmen."

What the authors say about the endebtedness of the seringueiro to the middlemen exposes the weakest spot in the industry of Brazil.

After dealing with Hevea, the authors discuss Manihot. Of species several are defined including a new one *Manihot Toledi;* and as regards them the conclusion is reached that generally it is best to plant *M. Glaziovii*, if it is a case of planting a Manihot, although of the smaller species *M. heptaphylla* and *M. piauhyensis* for instance might be planted, or *M. Toledi* which is intermediate in size.

The authors give a series of facts showing that about two centres in Brazil, Ceara rubber planting is taking a hold. They add that the wild plant has received such severe treatment that it no longer counts as a reliable source of commercial rubber.

The establishment of an experimental station to select, improve a nd experiment with Ceara rubber is set forth as desirable.

The last few pages of the book are devoted to a discussion of *Castilloa Ulei* and *Hancornia speciosa.*

Annual Report of the Board of Scientific Advice for India for the year 1913-14 (Calcutta, 1915). Among the records in this report of extensive work done, a few are of special interest in Malaya. In the report for 1912-13 it had been explained how in the soil of swampy paddy lands various gases are produced, notably methane or marsh-gas, nitrogen, hydrogen and carbonic-acid gas; and that after the paddy has been planted out a film forms on the surface consisting largely of bacteria, and minute green organisms such as algae and diatoms. Messrs. W. H. Harrison and Subramania Aiyar, continuing their work, show (page 9) how this film lives on the gases that exist as a result of changes within the soil and doubtless are in continual process of formation, using up the methane and the carbonic-acid gas (in part at any rate) with a liberation therefrom of oxygen. The function of this surface film is thus to liberate oxygen, so that the rice roots are more liberally aërated than they would be without it. Drainage of rice land by producing a flow of water through the film into the soil carries this oxygen to the rice roots below; but as too

great a drainage prevents the full development of the film, there is an optimum to be aimed at,—an adjustment of the water supply to the drainage, and the production of the right rate of percolation into the soil. Green manuring by increasing the output of gases in the soil, increases the activity of the surface film, and aided by the percolation increases the aëration of the soil in contact with the rice roots. The ploughing in, as we see it in Malaya, of sedges on rice fallows is green manuring. The authors appear to hold that the important benefit to be got from this is the indirect one of aëration at the roots of the rice.

On page 109 is given an important conclusion arrived at by Mr. C. M. Hutchinson, the Imperial Agricultural Bacteriologist, namely that with such soils as he used for experiment the most rapid and complete nitrification of any given quantity of nitrogenous organic matter could be effected in soil by producing anaërobic conditions with water saturation and subsequently draining and aërating; the rapidity with which nitrification takes place under these conditions depends upon the relative completeness of the anaërobic and subsequently of the aërobic conditions, i.e., the soil must be open.

Experimenting with lime, Mr. Hutchinson "found that decomposition of nitrogen-yielding manure was rapid in proportion to high lime content, although in time the soil lower in lime attained the same nitrate concentration". And lime we know goes a long way in keeping a soil open; but the connection of lime and nitrification is not yet established in detail.

In connection with forestry it is recorded (page 120) that "data showed large quantities of tan barks" to be "available in the mangrove forests of Tenasserim and Arakan, that they can be exploited at a reasonable cost, and that the local conditions are generally favourable for the erection of a factory."

Messrs. Grieve and Shebbeare have drawn attention to the circumstance that the unmixed forests of the Sal tree—*Shorea robusta*, Gaertn.—which occur in the Sub-Himalayan tracts of Bengal are there at any rate artificial; for if fire be withheld an evergreen undergrowth asserts itself against which the sal seedings cannot compete in spite of repeated clearings. This *Shorea* is thus seen to be a pioneer in reafforestation, for it appropriates to itself in time savannahs annually fired.

Proceedings of the Third International Congress of Tropical Agriculture, held at the Imperal Institute, London, June 32rd to 30th, 1914. (London John Bale, Sons, and Danielsson, 1914, p. xii-407. Price 10s. net). Abstracts of the papers read at the Congress, and full reports of the discussions are printed in these Proceedings, together with the opening address by the President, Professor W. R. Dunstan. The Transactions of the Congress containing the papers themselves, are in preparation.

Chief among the subjects dealt with are Technical Education in Tropical Agriculture, Organisation of tropical Departments of Agriculture in relation to Research, Agriculture Credit-Banks and Co-operative Societies; Sanitation on Estates, Legislation against Tropical pests, Fertility of Soils, Rubber, Cotton and other fibres; Cereals, Sugar, Cocoa, Tobacco, Oil seeds.

The Capitalist is a need in the Tropics; and experts from most of the warmer parts of the world were at the Congress to meet him; consequently a not inconsiderable part of the time of the sessions was occupied in his education; with this was interwoven the devout wish to attract scientific workers to the immense field open to them. The proposed College of Tropical Agriculture appeared conspicuously in the discussions, whereat both East and West laid claims to it.

As regards legislation against Plant diseases and Pests, the Congress met with no clashing interests. Never was there before any meeting a subject where discussion started with a more common purpose. It ended in the adoption of a motion by Dr. Warburg that a Committee should be appointed to formulate proposals in regard to points of difficulty in applying the suggestions of the International Phytopathological Convention of Rome. The paper which led the discussion will appear in the Transactions.

Pages 132-156 give the whole discussion on the subject of the variability of plantation rubber, and Professor Dunstan's summing up "that the time is premature for considering what may be called standardization."

A series of resolutions (pp. 385-407) closed the Congress:—

i. To appoint a Committee to collect information on the organization of Government Departments of Agriculture.

ii. To appoint a Committee to report on the question of estate sanitation.

iii. To arrange for the exchange of publications.

iv. To appoint a Committee to collect information on agricultural co-operation including credit, against the next Congress.

v. To appoint a Committee to support the London Committee which is promoting the establishment of an Imperial College of Agriculture.

vi. To appoint an International Committee to consider how far the proposals of the International Phytopathological Conference of Rome, 1914, are applicable to the Tropics; and that the official delegates should be asked to report this to their Governments.

vii-ix. Personal.

x. To support the formation of a British Institute of Tropical Agriculture.

xi. To appoint a committee to co-operate with the International Institute of Agriculture in Rome.

xii. To appoint a committee to discuss the internal affairs of the Association Scientifique d'Agronomie Coloniale et Tropicale, i.e., the organisation under whose auspices these Congresses are held.

Dr. J. D. Gimlette's "*Malay Poisons and Charm Cures*," (J. & A. Churchill, London, 1915, pp. viii + 127) and the *Rubber Receuil* of the International Rubber Congress and Exhibition, (Batavia, 1914, J. H. de Bussy, Amsterdam, 1914, pp. 614), are books recently published, which should find their way to every station in the Peninsula.

The poisonous Depu plandok mentioned by Dr. Gimlette on page 48 and elsewhere proves to be a new species of *Wikstroemia*,—*W. Ridleyi*, Gamble,—which is restricted to Pahang, Tringganu and Kelantan, as far as we know at present.

The Gardens' Bulletin

STRAITS SETTLEMENTS

into which is incorporated all that has been published as the third series of the Agricultural Bulletin of the Straits and Federated Malay States.

Vol. I | Issued March 31st, 1917. | No. II-12

CONTENTS.

	PAGE.
A report on Races of the Greater or Ten-months Yam—Dioscorea alata—cultivated in the Botanic Gardens, Singapore	371
The Lesser Yam—Dioscorea esculenta	396
Germination of the Seeds of Erythrina before falling ..	399
Scolia erratica, Smith, a parasite of the Red Coconut Weevil (Rhynchophorus ferrugineus)	399
The Flowering of the Pigeon-orchid, Dendrobium crumenatum Lindl.	400
Precocious flowering of Melia	405
Rainfall	406
New books	411
Index to Volume I.	412

To be purchased at the Botanic Gardens, Singapore; from Messrs. Kelly and Walsh Ltd., No. 32 Raffles Place and 194 Orchard Road, Singapore.

Printed at the Methodist Publishing House, Singapore.

DEPARTMENTAL NOTICE.

Seed of *Hevea brasiliensis*—Para rubber—as available from trees thirty years old or older, will be sold at three dollars per thousand up to the number of ten thousand, and at two dollars and fifty cents for every further thousand on the same order.

Plants of *Eucalyptus robusta* may be obtained at fifty cents each as far as available.

THE

GARDENS' BULLETIN,

STRAITS SETTLEMENTS

INTO WHICH IS INCORPORATED ALL THAT HAS BEEN PUBLISHED AS THE THIRD SERIES OF THE AGRICULTURAL BULLETIN OF THE STRAITS AND FEDERATED MALAY STATES.

The Gardens' Bulletin is published as material becomes available. Its price is fifty cents a copy, post free, or in advance for a volume of twelve numbers, or for any twelve numbers, post free,

Five dollars in the Straits and Federated Malay States.

Nine and a half rupees in India and Ceylon.

Thirteen shillings in Europe.

Subscriptions paid to the third series of the Agricultural Bulletin, Straits and F. M. S. are counted as subscriptions to it.

This double part completes volume I.

Singapore:
Printed at the Methodist Publishing House,
1917.

THE

GARDENS' BULLETIN,

STRAITS SETTLEMENTS.

Vol. I. Issued March 31st 1917. No. II-12.

A REPORT ON RACES OF THE GREATER OR TEN MONTHS YAM,—DIOSCOREA ALATA,— CULTIVATED IN THE BOTANIC GARDENS, SINGAPORE.

The first six plates illustrating this issue of the Gardens' Bulletin represent tubers of the Greater or Ten-months yam, a vegetable which might be cultivated more widely in the Malay Peninsula.

It is a starchy food, and supplies the place of the potato in several parts of the World, especially in the more moist parts of the tropics; for the potato, a native of the temperate parts of South America, is not a tropical plant, but is even grown in the Peruvian Andes at so great an elevation as 14,000 feet.

When the New World was discovered the potato was only spread in the continent of its own home, and limited by temperature it had not passed the Isthmus of Panama northwards. This passing of the Isthmus of Panama happened only when European voyagers took it to Virginia and to neighbouring parts. About 1535, when the conquest of Peru had been effected, the Spaniards brought the potato to Spain; and seeing how difficult it was to provision ships in those days, we may be sure that they made use of it for the purpose. Then in 1585, perhaps through the seizing of some Spanish ship, perhaps in another way, the potato was brought alive to Ireland; and Ireland adopted it. It was not welcomed however on the Continent of Europe, and was only just accepted in Great Britain in spite of earnest advocates such as Gerard, the King's

Herbarist to James I, whose portrait was drawn with a shoot of it in his hand: and favour did not turn towards it until years of scarcity came. Scotland adopted it only in 1740, and it required the distress of the Napoleonic wars to assist it to its place in northern Europe. Italy, which now exports so much, was particularly unwilling to have it at first. Yet for Europe in the sixteenth century in comparison with the vegetables then available it was unrivalled.

The Greater Yam is Dioscorea alata, a plant not at all allied to the Potato plant, although it furnishes a tuber which on chemical analysis is seen to be extremely similar. Dr. Hooper in the Journal of the Asiatic Society of Bengal, N. S. vii, 1911, p. 60, gave the following comparison:—

	Yam		Potato
Fat	1.02		0.46
Albuminoids	10.87		10.14
Carbohydrates	77.01	}	84.79
Fibre	5.16	}	
Ash	5.94		4.61

The Greater Yam is a native of the Eastern Tropics and has been cultivated from the Indian Ocean to the Pacific for a long time. Everywhere between these bounds, where the inhabitants had attained some small degree of civilisation over long ages it must have held an important place limited on the East and South by the Ocean and North by cold climates; further westward it was not spread because being a wet tropical plant—more intensely so than the Sugar-cane,—it was unable to reach the continent of Europe, even with the Moors, on account of the dry countries which separate India from the Mediterranean. It remained unknown to Europeans until the Portuguese found it and provisioned their ships with it.

The same adventurous age which brought both the Potato and the Yam to European knowledge was the age which took the yam to the New World, a competitor there with the tapioca plant, but hardly with the potato.

However in India the yam and the potato came into competition in the northern part of the country, and the yam lost favour before its rival. But while the potato is cultivable in the Bengal plains, and on the plateaux further south, so that Bombay gets a supply from the Ghats behind it and the Madras Presidency has a small supply from the Nilgiri Hills, it is not cultivable in the plains south of the Tropic of Cancer; which means that over a very large part of India the Greater yam has not been thrown into competition by being grown and marketed alongside the potato, and throughout the villages, of course where the rainfall is adequate, it retains its old place as the chief of edible stachy tubers. Also it still holds a place above the potato elsewhere on account of the backwardness or the peculiar local conservatism of the inhabitants.

The Malay Archipelago as regards the potato is like the Madras Presidency: it has mountains where the potato can be grown, and lowlands where it cannot: but European enterprise has touched so little of the mountains, that the possibilities are developed nowhere except in Java: and under the existing circumstances the Greater Yam is a desirable vegetable.

Two drawbacks have to be admitted at the outset, namely the time that the crop is in the ground, and the circumstance that owing to its mucilaginous nature, it boils badly; but in this Bulletin, No. 9 pp. 304-305, other ways of cooking it have been given.

The writer began the study of yams conjointly with Sir David Prain when in India; and a collection of living plants was got together in the Royal Botanic Gardens, Calcutta, not only from all parts of India, but also from Ceylon and by the kindness of Mr. W. Jackson, of the Queensland Sugar Refining Co., from Fiji. Much of the material was examined and gradually discarded for one reason or another, and most particularly because the climate of Calcutta proved unsuitable for the more slowly maturing southern races: but in 1914 Major A. T. Gage, now Superintendent of the Royal Botanic Gardens, there, was so good as to send to Singapore a selection from what remained. This, together with two collections from Manila, one from Saigon, one from Port Darwin, two from the Gold Coast and two from Southern Nigeria, and also some local races, forms the new Singapore collection. To the Department of Agriculture of the Philippine Islands, through Mr. O. T. Barrett, and to Professor C. F. Baker, of the College of Agriculture, Los Banos, P. I., Singapore is indebted for the Philippine Yams, including one from the Caroline Islands and several from the Island of Guam. To Mr. C. E. F. Allen, formerly Curator of the Botanic Station, Port Darwin, Singapore is indebted for the tubers from Northern Australia. To M. Morange, of the Botanic Gardens in Saigon, Singapore is indebted for the tubers received thence: and to the Botanic establishments of the two African colonies for the tubers which were sent through Kew to Singapore.

The Philippine collections were reported on briefly in this Bulletin No. 9 pp. 297-304 and also in the Philippine Agriculturist and Forester iii. 1915 pp. 205-209, the object of the reports being rather to indicate the range of variation observed in a preliminary investigation that to classify the races. In this report however, the lines of a classification will be laid down; but the whole collection can by no means be brought under discussion.

Many of the races of yam, now being grown, have been obtained from far away, witness those from West Africa, and in spite of the most excellent packing the roots unavoidably suffer on the way. The procedure on arrival of a consignment is this:—the tubers are unpacked and examined, the dead tissue is cut away, and the outside of the living tissue treated with permanganate of potash; then what has been saved is planted. In every case new

comers have been planted on the slope behind the Director's house, for the convenience of watching them: but the soil is there very inferior: and therefore as soon as possible the plan adopted has been to remove the stock to better soil in the Economic Gardens. But before this can be done the stock has had to be built up from the small beginning, and in the cases where the original tuber arrived in a very bad state more than one year has been requisite.

All the races to be reported on below, have had a year of cultivation in Block 14 of the Economic Garden in a place where the soil is a moist and good loam with but one fault—that it contains too much rotting timber.

There is an axiom in work of the nature of this study—that the plants must exist under the best possible conditions, for otherwise they do not exhibit their characters fully. It has been impossible to give them better conditions.

In 1914 when the work now in hand was commenced in Singapore, planting was done in the first week of February, except for a few tubers received too late, and digging was done in the third week of October, so that the crop was on the ground for 8½ months. For 1915 planting was done in the first week of December, 1914, and digging in the very end of September, 1915, so that the crop was on the ground for almost 10 months. For 1916 planting was done in the second week of December, 1915, and up to the New Year; and digging was done in the end of August and in the first half of September, 1916, so that the crop was on the ground for 9 months.

In 1916 it occupied an area of rather more than one quarter of an acre.

No. of sets planted 643
Area occupied 12,518 sq. feet or .287 acre = 1,163 centaires.
Yield, all included, 4398½ lbs. = 1995.7 kilos.

No. of races represented.	
of local origin	2
of Indian origin	14
of Saigon origin	4
of Philippine origin	37
of Australian origin	1
of Guam origin	4
of Caroline origin	1
of Fijian origin	20
of West African origin	10
of uncertain origin	2
	95

Average No. of plants of each race 6.77

Average yield per plant 6 lbs. 13 oz. = 3.09 kilos.

Greatest average yield of any race 17 lbs. 10 oz. = 8 kilos.

Greatest yield of any plant 30 lbs. 2 oz. = 13.7 kilos.

Rate per acre 12623.7 lbs. = 12 cwt. 2 qrs. 23.7 lbs.

Rate per hectaire 2321 kilos.

Before going any further it is convenient to state the chief characters in which the races differed from each other, everyone of which must be taken into consideration in building up a sound scheme of classification, and of which the degrees of importance have to be guaged.

(i) the variation in the colour of the tuber,—whether with magenta sap or without,

(ii) the variation in the whiteness of the flesh, apart from the magenta sap, whether ivory white or with an ochre tint,

(iii) the variation in the consistence of the flesh,

(iv) the variation in the length of the tuber,

(v) the variation in the number of tubers, whether solitary or twinned or more than twinned,

(vi) the variation in the evenness of the tuber, whether branched or not,

(vii) the variation in the corkiness of the skin,

(viii) the variation in the number of rootlets over the surface,

(ix) the variation in the position of swelling, whether high up or low down,

(x) the variation in yield,

(xi) the variation towards earliness or lateness,

(xii) the variation in keeping power, whether the tuber can be made to rest or cannot,

(xiii) the variation in the presence of magenta colour in the above-ground parts,

(xiv) the variation in the size of the frills on the stem,

(xv) the variation in the production of prickles,

(xvi) the variation in the outline of the leaf, whether the auricles are rounded or are not,

(xvii) the variation in the degree of glaucousness at the back of the leaf,

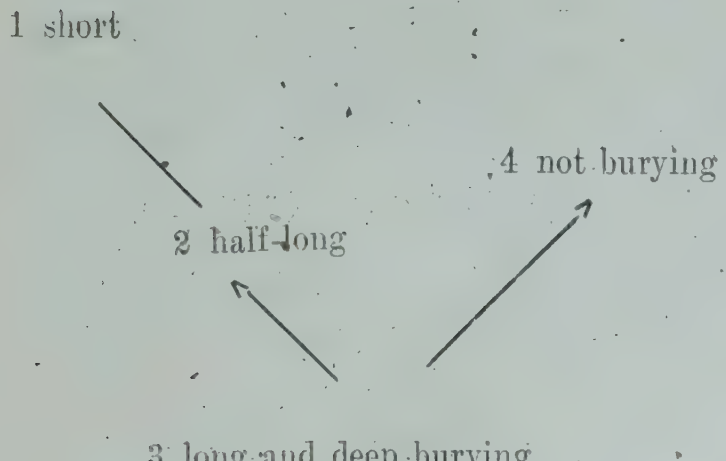
(xviii) the variation in the production of bulbils, etc., etc,

In guaging what degree of importance, is to be assigned to each of the above, the first consideration is that man has selected the Greater Yam from something growing wild, and therefore we must ascertain as far as possible what appearance the wild parent had, and what characters the first cultivators would be likely to consider. Now the Greater Yam has several close allies among the wild yams of Eastern Tropical Asia: and if not from these, from something very similar it must have taken its origin. These allies grow in moist regions where forest prevails, finding their opportunities for vigorously fruiting where the canopy of overhead foliage has been disturbed, and the sunlight let in. They have tubers which are buried deeply in the soil out of the reach of being uprooted by wild pigs; and these tubers are white fleshed and esculent, having none of the poisonous principle which is present in the tubers of those more remote species of Dioscorea which are surface rooting. The tubers are thin, thickening a little downwards, but not greatly, and they may branch a very little, or not at all. Jungle tribes eat the wild yams of this type: but it is not much that they return for the labour of digging them out. Once the writer engaged a woman of a jungle tribe to dig wild yams for him from a forest in Northern Burma where they are particularly common, and obtained less than a meal for two persons as the result of four hours work. But without doubt from wild yams yielding such a meagre return, jungle man commenced the selection of the Greater Yam. First the tribes would eat what they could find: then becoming more settled in habitation they would find it necessary to encourage the plants to grow about the settlements, and would protect them a little: thirdly they would plant them in the immediate neighbourhood of the villages: and out of this procedure they would evolve a regular cultivation, selecting naturally the parents for propagation which were most productive. The second stage of development being reached in this way, it would be realised advantageous to grow plants with abbreviated tubers so that the tilling might be less laborious and the digging out more easily accomplished. Therefore, second to yield, man would operate on the length of the root, which in this stage of social development he could now protect against uprooting by wild pigs—at least in some measure.

It is perfectly certain that he would not select for excellence in flavour at this stage, for the jungle man everywhere eats apparently by no means unwillingly, the most nauseous vegetables. Colour he might select for, as a toy which pleases, long before thinking of palatability. Shape of leaf, rootiness of the tuber, upgrowing fleshy shoots, and other such characters, he would not notice. All these variable features, then, may be put down as secondary to the length of the tuber; and in that feature the first division in the classification of the races will be based.

If a yam be examined, it will be noticed that at the top the tissue is rather hard and woody: that hardish tissue is a part of a perennial underground "stem:" and it produces the new annual shoot or shoots, and new roots each successive year, whereof one, perhaps more than one, becomes fleshy and swells up into the annual tuber. This tuber is so built into the bit of stem, that it is difficult to tell where the one ends and the other begins, and the stem sometimes sends up short shoots in the autumn which are themselves fleshy. Races vary among themselves much in this peculiarity, which as it appears not to occur in any wild allies, must have stepped in during man's period of modifying the plant: but it does not seem clear how he would look upon it in selecting, unless as it spoils the eveinness of the tuber he would select against it. Yet there is the feature to be reckoned with.

Just as unsought for would be another development, which happens on the other hand to have served man's purpose, and to have been seized on by him for the production of a curious group of races which do not bury their tubers: the group has been as it were side-tracked, and forms the development illustrated on plate 6. Assuredly in the ancestral condition, the yam plant sent its succulent tuber deeply into the soil: and certainly if it had not done so wild pigs and such animals would have destroyed it from off the face of the earth: but after man had taken the yam into domestication and was protecting it, certain plants apparently lost the tendency to send their fleshy root downwards,—they lost somehow the responsiveness to gravity that they should have, and produced tubers which, while elongating, still remained at the surface. Such plants can be cultivated by earthing up: and they were propagated evidently as convenient for growing: they could for instance be planted in the midden at the back door, which grew with them. These peculiar races deserve a special place in our classification, which we may start with a diagram as follows, side-tracking them:—



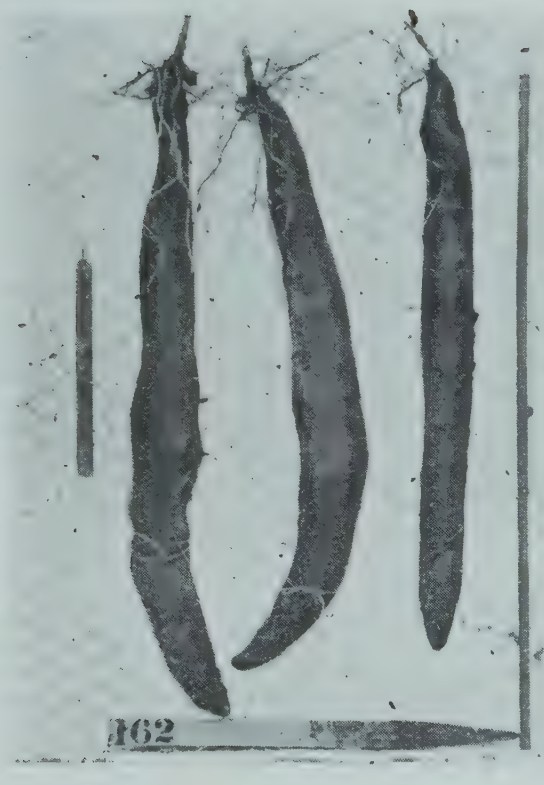
Under these four heads the yams will be considered.

Opposite plate I.

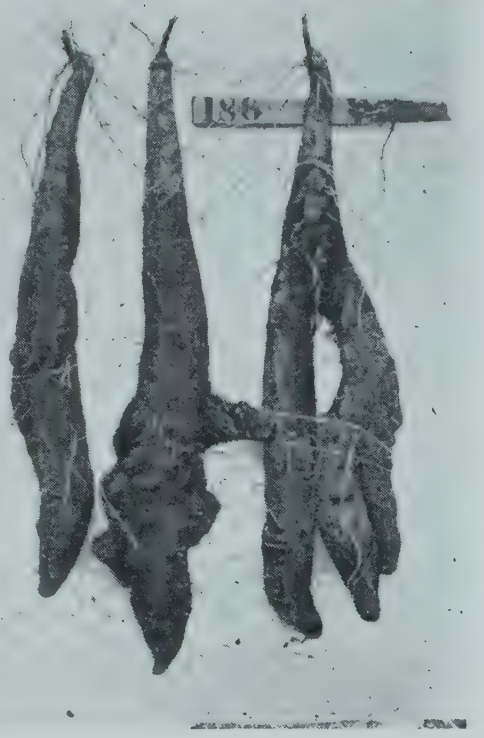
SOLITARY UNBRANCHED DEEP-GOING TUBERS RATHER THIN.

Registered No.	Origin.	No. of plants.	Average Weight lbs. oz	grammes.	Yield per acre in tons *
162	Khasia Hills "Phan Shriew" 35606	7	6-4	2835	6.28
110	Fiji, 20715	4	6-11	3033	6.72
	SOLITARY, DEEP-GOING, RATHER THIN TUBERS WITH A TENDENCY TO BRANCH.				
186	Nowgong, Assam 35575	5	8-15	4054	8.97
112	Khasia Hills "Phan Suri," 35623	9	4-1	1833	4.08
120	Fiji, "Boti," 20692	4	6-9	2977	6.59
	SOLITARY DEEP-GOING TUBERS WHICH SWELL RATHER TOWARDS THE EXTREMITY.				
156	Fiji, 20702	8	6-5	2863	6.34
108	do. 21693	9	9-6	4252	9.47
136	do. 20692	7	9-8	4309	9.42
	SIMILAR BUT MORE CLAVATE.				
118	Fiji, 20710	4	7-12	3515	7.78
114	do. 20714	3	8-8	3815	8.54
116	do. 21686	2	4-5	1956	4.33
54	Philippine Is. 1044	2	4-8	2041	4.52

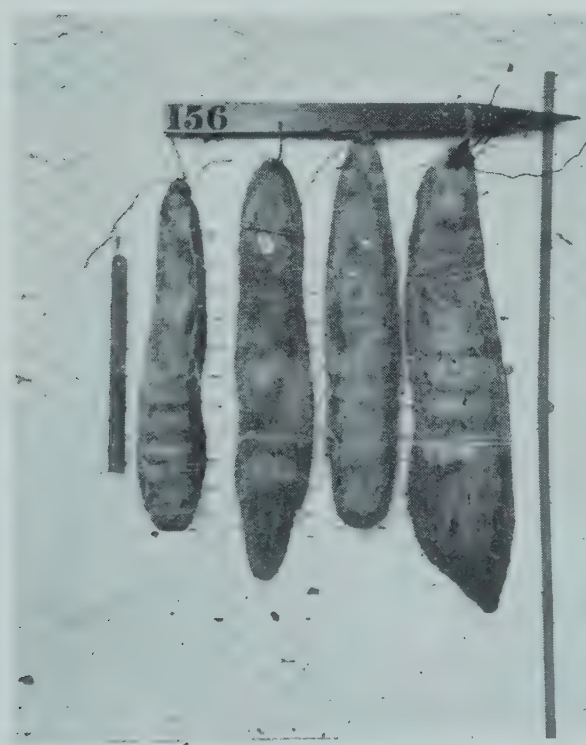
* These rates per acre are worked out on 2250 hills to the acre, a number which might easily be exceeded.



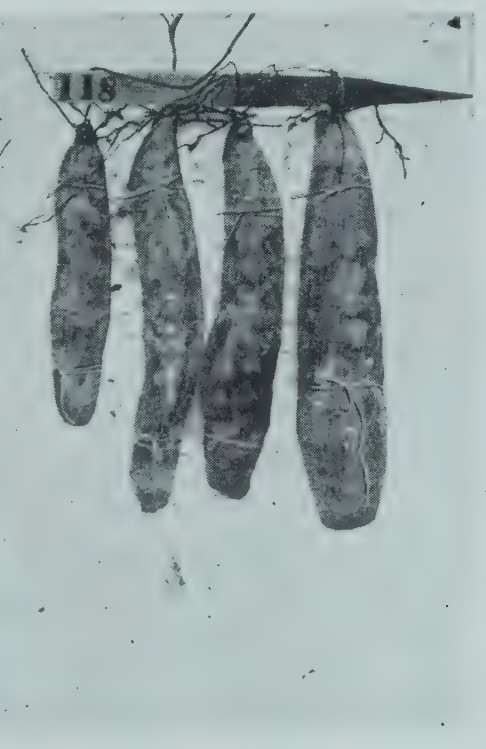
Yam No. 162: origin, Assam: flesh white with magenta under the skin: yams descend deeply.



Yam No. 186: origin, Assam: flesh yellowish: yams descend deeply and then branch.



Yam No. 156: origin, Fiji: flesh white: yams descend rather deeply and are bulky.



Yam No. 118: origin, Fiji: flesh white with a little magenta sap under the skin: yams descend rather deeply.

Deep going tubers.

Deep-going tubers (descending vertically and elongated) without uprising shoots, not exhibiting twinning, nor branching,—such, because their characters appear ancestral, we start with. On plate 1 to the left of the metre measure, which makes a division down the centre are figured three tubers of race No. 162. The length attained was just one metre or 39 inches. There was no flattening, and the even surface was very free from rootlets. The skin was of a particularly dark brown: with just under it a layer of the flesh holding magenta sap: the inner part of the flesh was quite white. The first parental tuber of this race was one collected for the writer by Babu R. K. Das on the south face of the Khasia Hills under Cherrapunji and he reported that the Khasias use the tuber curried, and say that it is irritant raw. The largest tuber in 1916 weighed 10½ lbs. (4763 grammes); and the average weight was 6¼ lbs. (2835 grammes).

In the collection there are other similar races, but only one of them can as yet be reported on, namely No. 110 from Fiji. It possesses a similarly smooth skin, but of a lighter colour. The average return in 1916 was similar, namely 6 lbs. 11 oz. (3033 grammes).

Of characters, which are among those considered secondary, these two also proved to be similar in that they possess rounded auricles to the largest leaves, but the degree of roundness so far observed differs: the second exhibited prickles on the stem, but neither up-growing fleshy shoots, and both have some magenta sap in the surface of the tuber, and both are without it in the vegetative parts. Thus they were found closely related although not identical.

The figures of production show them no better than races with short tubers: and unless it may be for a delicacy in the deeply buried parts of the tubers as a consequence of being grown remote from the air* (an effect akin to that produced by earthing up celery for instance) there appears no advantage in cultivating them where races with shorter tubers could be raised.

Deep going tubers, (as the last two), but with a tendency to branch. The yam No. 186 figured on the right half of the upper part of Plate 1 differs from that on the left in a tendency to branch. The depth to which the roots went was almost the same, but they were not so easy comparatively to dig out unbroken on account of this branching. The surface was less smooth and carried more small rootlets than that of No. 162. Under the skin there was no magenta sap: and the flesh in the interior was yellowish. Cooked, the race appeared a good one: but comparative methods of judging comestible value with regard to these yams have yet to be devised. The yield of the largest tuber was 14 lbs. 2 oz. (6407 grammes) and the average for the five plants was 8 lbs. 15 oz. (4054 grammes).

---

* The Afon or Yellow Yam of Jamaica produces a bitter flavor in any parts of its tubers exposed to the air (Harris, in Bull. Dept. Agric. Jamaica, 1909, p. 4).

Opposite plate 2.

ELONGATED AND TWINNED.

Reg No.	Origin	No. of plants.	Average Weight lbs. oz.	grammes.	Yield per. acre in tons
68	Philippine Is.	10	11-7	5188	11.48
30	do.	4	15-5	6946	15.38
20	do.	4	7-2	3232	7.16
	HALF-LONG.				
76	Philippine Is.	23	10-14	4933	10.92
10	do.	8	13-1	5925	13.12
106	Fiji	6	7-6	2345	7.41
128	Sylhet or Khasia Hills	5	8-5	3689	8.35
	SHORT.				
70	Caroline Is.	17	6-4	2835	6.28
26	Philippine Is.	8	2-0	907	2.01
48	do.	8	4-2	1871	4.14
126	Probably Philippine Is.	6	2-7	1106	2.44

Yam No. 68: origin, Philippine Islands: flesh white with magenta sap under the skin: the yams are clustered, and descend deeply.

Yams Nos. 76 and 70. No. 76: origin Philippine Islands: flesh white: in shape the tubers are much as those of No. 118, but there is a tendency to the production of uprising shoots. No. 70: origin Caroline Islands: flesh white with a very little magenta sap under the skin and a few flecks of magenta more deeply: yams round and excellent.

This race came from Assam just as did No. 162. But instead of being a Khasia Hills race it was obtained at a forest-buried stream-side village inhabited by Mikirs, where the depth of the soil must have suited it admirably, and where wild animals abound such as would destroy surface rooting races.

The adjoining Khasia Hills furnish other similar races and one was grown under the number 112, collected in 1911 for the writer under the name of Phan Suri, and considered by the Khasias living under Cherrapunji as the best of all yams. Like No. 186 it had pale yellow flesh. Nine plants yielded an average return of 4 lbs. 1 oz. (1833 grammes) or at the rate of nearly 4 tons 2 cwt. per acre.

Again a not dissimilar race appeared among the plants of Fijian origin, namely one called there "Boti" and numbered 120, and another without a vernacular name numbered 110. The surface of the tubers was rooty: the flesh was yellowish, with just a very little magenta sap under the skin. The yield was on the average 6 lbs. 9 oz. (2977 grammes) which works out at the rate of nearly 6 tons 12 cwt.

As regards minor characters, all the three races with these elongated tubers possessing the tendency to branch, have similarly shaped foliage, the auricles of the largest leaves being rounded: but whereas the two Assam races possess no magenta sap, neither in stem nor in tuber, the Fijian race, No. 120, has a little in the tuber and in the frills of the stem. It alone is without prickles. That three of them have a yellowish flesh may prove of some interest.

The Fijian races, Nos. 156 and 118, which are represented in the lower block of plate 1, differ from the races of the last groups chiefly in length, and a tendency to thickening into a club. Similar to them are five other races now to be reported on, namely Nos. 108, 114, 116 and 136 from Fiji, and No. 54 from the Philippine islands.

If the reader will kindly turn to the plate he will see that No. 156 on comparison with No. 162 above, is not only shorter, but is more covered with rootlets. Its flesh is white, magenta sap being absent entirely. The average yield was 6 lbs. 5 oz. (2863 grammes) or nearly 6 tons 7 cwt. per acre.

No. 108 agreed in tuber exactly with No. 156, but yielded more heavily—9 lbs. 6 oz. or 4252 grammes, the return per acre being almost 9½ tons.

No. 118 differed from No. 156 in possessing a little magenta sap in a layer under the skin. Its average weight was 7 lbs. 12 oz. (3515 grammes) or at the rate of 7 tons 15½ cwt. per acre.

No. 114 agrees very closely with the last, having the same shaped tuber and similarly a little magenta sap under the skin. Its average return was 8 lbs. 8 oz. (3854 grammes) or at the rate of 8 tons 10½ cwt. per acre.

No. 116 differed in having a smaller tuber and its average yield was only 4 lbs. 5 oz. (1956 grammes) or at the rate of 4 tons 6½ cwt. per acre.

No. 136 was again longer and made a return of on the average 9 lbs. 8 oz. (4309 grammes), one tuber attaining 22 lbs. At the rate of 9½ lbs. per hill, the yield per acre would be nearly 9 tons 11 cwt.

The race of Philippine origin, No. 54, exhibited tubers which are white fleshed, without any magenta sap, and they seemed to be more susceptible to injury than the other similar tubers. The average return was 4½ lbs. (2041 grammes) which per acre works out at 4 tons 4 cwt.

One Khasia hill race, No. 168, produced a tuber of the same shape as these now under discussion, but with this difference, that the knot of stem tissue at its head gave rise to many fleshy uprising shoots at the end of the season's growth. There was no magenta sap in the tuber, and the flesh was white, not yellowish. The average yield of the plants was 4 lbs. 15 oz. (2240 grammes) or per acre 4 tons 19 cwt. However it is thought that the race for some reason has not yet had a fair trial.

In review of these races with the slightly club-shaped tubers it may be remarked that magenta sap when present is only found in small quantities; and that most of the races have clean-looking tubers from the absence of small rootlets. As regards the stems one of them (No. 136) possesses prickles. All but the last two, Nos. 54 and 168, are Fijian, and one of these last two namely No. 54, breaks away from the group in its leaves having the venation more than usually prominent. As regards the auricles of the largest leaves, the Fijian races differ among themselves, but there is a tendency for these to be more nearly acute than they are in the foregoing groups.

The upper block on plate 2, represents a race in which the tubers are not solitary, but are produced two, three or more together. This is a very different thing morphologically from the branching which has been described above in regard to plate 1, for whereas in race No. 186 which served for the figure on plate 1, the tuberous root branches, in race No. 68 which is figured on plate 2, and is now under discussion, there arise from the stem-tissue at the head of parent tuber, more than one root destined to swell into a tuber; it is indeed quite a different proceeding on the part of the plant, to form two or more similar organs, where the formation of one is usual, from the other case which is branching. No. 68 is a race from the Philippine islands. Its tubers have a dark skin, free from rootlets; and under the skin there is a layer of tissue holding magenta sap, the flesh being white. The average yield was 11 lbs. 7 oz. (5188 grammes), one plant returning 30 lbs. 2 oz. (13,664 grammes), which works out at 11 tons 9½ cwt. per acre.

No. 30 from the Philippine islands proved similar in characters, but perhaps the flesh was a little more yellow. Its yield on the average was 15 lbs. 5 oz. (6946 grammes) or at the rate of 15 tons 7½ cwt. per acre.

Again No. 12 from the Philippine islands proved to be rather similar; but its tubers were more commonly twins only, instead of being as in the foregoing in number more than twins. The skin of the tuber was rather rooty: and when it was bruised, the flesh exposed very quickly turned orange. The average yield was 7 lbs. 2 oz. (3232 grammes) or at the rate of 7 tons 3 cwt. per acre.

In leaf-characters all these three Philippine races shewed a close similarity, having the auricles of the largest leaves peculiarly elongated. In the year 1915 they were all late in sprouting from the ground and also early in dying down, thus being short-seasoned. The conditions, however, in which they were then being grown were not ideal, and the twinning did not assert itself; so that No. 68 was figured in the Philippine Agriculturist and Forester iii. p. 207 fig. 12 as a solitary tuber. The stem characters of the three are similar, just as we have seen the leaf characters to be; but in rootiness of the tuber and in the behaviour of the flesh on exposure to oxidation differences are observable.

HALF-LONG YAMS.

On Plate 2 the upper line of the lower block represents a type of yam by no means uncommon where this vegetable is grown. There are six tubers in the row, the outer two at each end having no uprising shoots, thus showing a variability in regard to this peculiarity. The race showing this feature is No. 76, and of Philippine origin. The tubers in shape are lumpy and bulky, having an average weight of 10 lbs. 14 oz. (4933 grammes), at which rate the yield per acre would be nearly 11 tons.

The Fijians seem particularly to favour races yielding tubers of this shape, so that in the large consignment which Mr. Jackson was so good as to send to us in 1902 fully three quarters of the total had it. But many of the races which he supplied have dropped out of our experimental cultivation, leaving as representing the type No. 106.

No. 128 obtained from the South face of the Khasia hills or from the plain below produces lower uprising fleshy shoots than did the plants of 76 possessing them. The flesh is white: and the greatest tuber weighed 18 lbs. 15 oz. The average return was 8 lbs. 5 oz. (3770 grammes), and at this rate the yield per acre would be 8 tons 7 cwt.

No. 106 produces tubers which externally are remarkably smooth and free from rootlets. Beneath the skin is a layer containing magenta sap; and of the magenta sap again there may be a little more deeply in the otherwise quite white flesh. Its average yield was 7 lbs. 6 oz. (3345 grammes) or at the rate of just over 7 tons 8 cwt. per acre.

Race No. 10 from the Philippine islands which judging by the figure of the only tuber raised in 1914 (this Bulletin, No. 9 p. 299 fig. 2) appeared a "Long Yam," on further cultivation and with more material for examination comes to be classed as a "Half-long Yam." It is a heavy yielder, the tuber of 1914 having weighed 16 lbs. 9 oz. (7513 grammes); then on poorer soil in 1915 it returned an average of 9 lbs. 6 oz. per hill; and in 1916 it returned an average yield of 11 lbs. 1 oz. (5018 grammes) or per acre 11 tons 5 cwt. The skin is free from rootlets. Under it is a layer of tissue containing magenta sap; and again through the flesh is magenta sap diffused so as to give it almost the tint of crushed strawberries.

Race No. 18, also from the Philippine islands, which furnished figure 5 on p. 299 of this Bulletin is a bulky half-long yam. In 1914 it yielded one tuber weighing 7 lbs. 7 oz. (3374 grammes). In 1915 it returned an average yield of 6 lbs. 6 oz. (2892 grammes); and in 1916 it yielded on the average 6 lbs. 7 oz. (2920 grammes) or at the rate of 6 tons 9½ cwt. per acre. It has but few rootlets on the surface of the skin; and no magenta sap. It is well reported on as a table yam.

The race No. 8 is again another from the Philippine islands; and, the first tuber which it produced in Singapore, was figured in this Bulletin p. 299 figure 1. Further cultivation shows that it has in some degree a tendency to produce twin tubers, although not so strongly as in those races which have already been discussed. In 1914 the tuber which it gave weighed 9 lbs. 13 oz. (4448 grammes); in 1915 the average yield was 8 lbs. 8 oz. (3855 grammes); in 1916 when twenty one plants were raised, it returned an average of 13 lbs. (5897 grammes) or per acre nearly 13 tons 2 cwt. The flesh is yellowish with just a trace of magenta sap in the layer under the skin: and it is very mucilaginous.

As regards minor qualities, these Half-long Yams, most of them being of Philippine origin, vary somewhat in regard to the shape of the leaf; but they vary in no way as regards the absence of prickles from the stem. As regards the foliage, No. 76 has conspicuously rounded auricles on the largest leaves; No. 18 somewhat approaches it; but the others possess auricles drawn out more or less into a point. The uprising fleshy shoots of Nos. 76 and 128 have already been mentioned; it remains to add that No. 8 at times also produces them. The first and the last of these three have yellowish flesh.

The races illustrated by plate 3 are Half-long Yams which produce great numbers of these fleshy uprising shoots. Both were obtained in Singapore: the upper one, No. 2, was obtained from the deserted garden at the top of Bukit Timah, where probably some caretaker, and if so most likely a native of the Madras Presidency, had planted it: and the lower No. 6 was obtained from a market in the town.

No. 2 is the quickest to sprout of all the yams that have been under observation: this quickness is a great fault, for it means that the yams in store will not keep, but shoot out stems and deplete

themselves in the attempt to grow. In 1914, when first brought under observation it produced a tuber weighing 17½ lbs. (7938 grammes). This large tuber was cut up and replanted returning yams of various weights from 15½ lbs. (7031 grammes) downwards, the average being only 6 lbs. 12 oz. (3062 grammes). Dug then in September, they had sprouted very freely and produced long shoots, much depleting themselves before they could be planted again on November 29th, 1915. Probably in consequence of this in 1916, and for a second time, the return failed by a long way to approach at all the promise of the first year, and was on the average 6 lbs. 13 oz. (3090 grammes). If the reader is interested enough to turn to p. 307 of this Bulletin (No. 9) he will observe from the figures on the bottom line of the tabular statement there given with what rapidity the tubers in 1915 when planted sent their shoots above ground. No other yam of all then under observation did the same.

As a large number of plants had been raised in 1916 some three hundred lbs. of tubers were distributed among the Gardens labour force along with tubers from other races for a comparative test; and the report was made that this yam was better to eat than the others. But in connection with this there arises the question as to whether the preference could be due to some of the flavour and softness depending upon the more plastic condition of the contents of the tuber in consequence of growth occurring, *i.e.* on changes connected with the want of keeping power, rather than to any excellence which would exist if a means of arresting the growth were found.

The tabular statement on p. 307, above referred to, shows that as different parts of the tubers vary in keeping power, by separating the woody stem portion from the root portion the keeping power of the latter can be increased.

Yam No. 2 will be the subject still of particular attention: and it is at the same time a race of considerable interest on account of the enormous number of upgrowing fleshy shoots that it puts forth. The illustration unfortunately cannot be made to show the rudimentary leaves which demonstrate these to be stems.

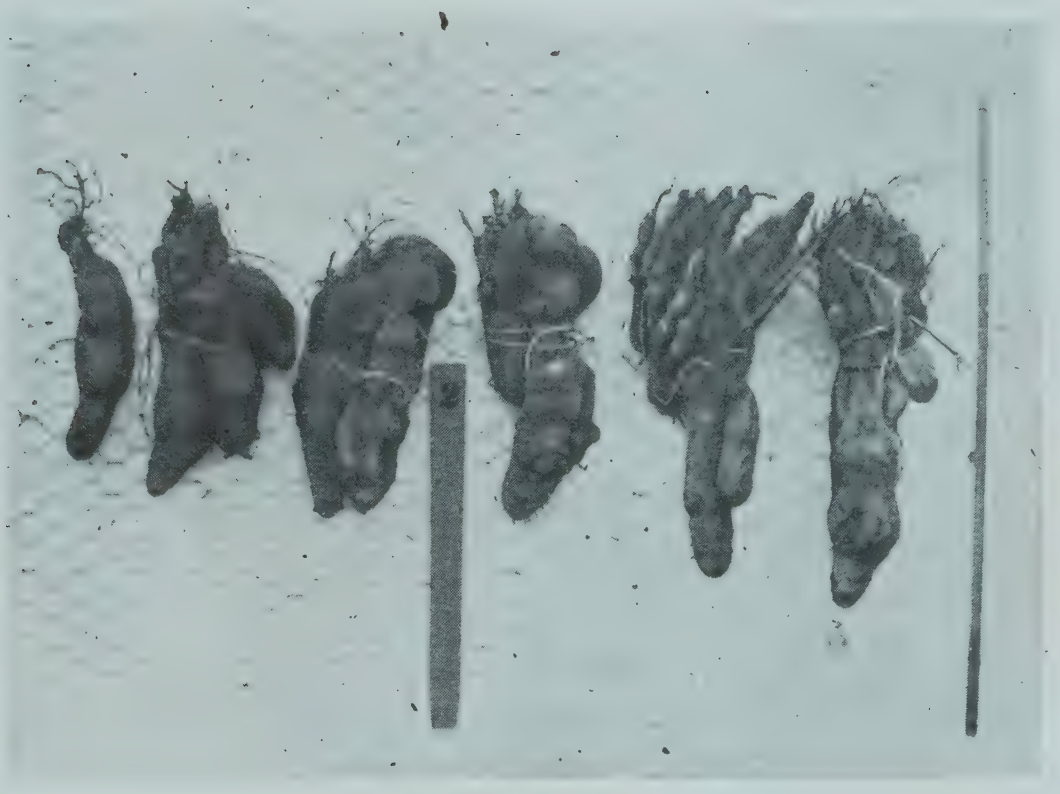
Race No. 6 which is figured on the lower half of plate 3 is, like the last, also of Singapore origin and similarly has many uprising fleshy shoots. But the keeping qualities are good, as a reference to p. 307 will suggest, for the sets when planted took 37—125 days to send shoots above ground: and not a single set of the race No. 2, which has been shown to be noteworthy for the rapidity of its spouting, was later than the earliest of its sets. The skin of this yam, No. 6, is remarkably thin and very easily bruised, and removed in flake-like pieces. Magenta sap occurs in the flesh at all depths. If not identical with a yam sold freely in the Rangoon markets as Myouk-u-ni, it is extremely similar.

In 1916 there were planted two groups of sets of the race, which had been separated on account of a difference in the intensity of the magenta colour observable in 1915: but unfortunately

Opposite plate 3.

RATHER LONG WITH UPRISING SHOOTS.

Reg. No.	Origin	No. of plants	Average Weight lbs. oz.	grammes	Yield per acre in tons.
2	Singapore	44	6.13	3090	6.84
6	do.	25	6.13	3090	6.84
150	Fiji	4	4.12	2155	4.77
18	Philippine Is.	10	6-7	2920	6.48
8	do.	20	13-1	5925	13.12



Yam No. 2: origin, Singapore: flesh yellowish: yams in shape as No. 76, but with a very strong tendency to produce uprising shoots.

Yam No. 6: origin, Singapore where it is known as Ubi merah: flesh with abundant magenta sap at all depths: uprising shoots abundant, but shorter than in No. 2.

one of these groups suffered very much from white ants,—the group with most magenta sap, and did not yield up to anticipation. Whether the way in which it suffered was connected with the delicacy of the skin, or was not, is uncertain; but it must be remarked that no other race suffered in the same way; and no other race has been noted as having a more delicate skin. Again in 1915 it suffered rather considerably from slugs, which made pits into the tissue feeding on it.

The group of sets with the greater amount of magenta sap returned an average weight of 7 lbs. 3 oz. (3260 grammes) or at the rate of 7 tons 4½cwt. per acre: the other group returned an average weight of 5 lbs. 12 oz. (2608 grammes) or at the rate of 5 tons 15½ cwt. per acre.

Both races, 2 and 6, produced an enormous number of bulbils. In 1915, 15 lbs. (6804 grammes) of bulbils were picked up off the ground under a row of fourteen plants of No. 2, and this does not represent the total weight produced.

In minor characters the yams which are now under discussion, all being characterised by abundant uprising fleshy shoots, varied so greatly as to make it seem quite possible that an undue prominence may have been given here to the possession of these shoots. The first two, *i.e.* Nos. 2 and 6, had no prickles on the stem but the Fijian No. 150 had. No. 2 produces leaves of quite ordinary shape: but No. 6 produces leaves which are almost hastate. No. 150 was noticed to have the nerves rather prominent at the back of the leaf-blades, more so than the others.

SHORT YAMS.

On Plate 2 at the very bottom, is illustrated yam No. 70, which from the culinary point is perhaps the best of all that have been grown. As the figure suggests, it is far from being a heavy yielder: but in 1916 the largest tuber produced weighed 10½ lbs. (4763 grammes), and the second largest 10 lbs. 2 oz. (4593 grammes), the third 8½ lbs. (3855 grammes) and the fourth 7 lbs. 15 oz. (3600 grammes), but the average of the whole however was only 6 lbs. 4 oz. (2835 grammes).

In 1915 the soil in which the races of yam were grown was not good; but this race returned proportionately well.

Its tubers are rounded, and quite smooth: the flesh is ivory white, with just a little magenta sap in the layer which underlies the skin and traces deeper in the tissue. Its return per acre at the above average would be 6 tons 5½ cwt. It keeps well, and sprouts tardily.

Race No. 26, which was figured in the Gardens' Bulletin on p. 299 as figure 9, is a Philippine yam very similar to the last: and also very good for the table. Its flesh is ivory white and rather firm, without any magenta sap. Its average yield in 1916 was only 2 lbs. per plant (907 grammes).

Opposite plate 4.

FINGERED AND OFTEN FLATTENED TUBERS.

Reg. No.	Origin	No. of plants	Average Weight lbs. oz.	grammes	Yield per acre in tons.
170	Port Darwin	13	7-2	3232	7.16
22	Philippine Is. 1019	16	17-1	7738	17.14
64	do. 1040	6	17-10	7995	17.70
102	Saigon, "Khoai-mo"	8	2-13	1276	2.82
66	Philippine Is. 1046	6	7-2	3232	7.16
174	Saigon, "Khoai tiem"	9	4-10	2098	4.65
90, 92, 94	Guam I.	3	11-7	5188	11.48
100	Saigon, "Khoai-noc-trang"	5	11-2	5046	11.17

FINGERED IN A LESS DEGREE.

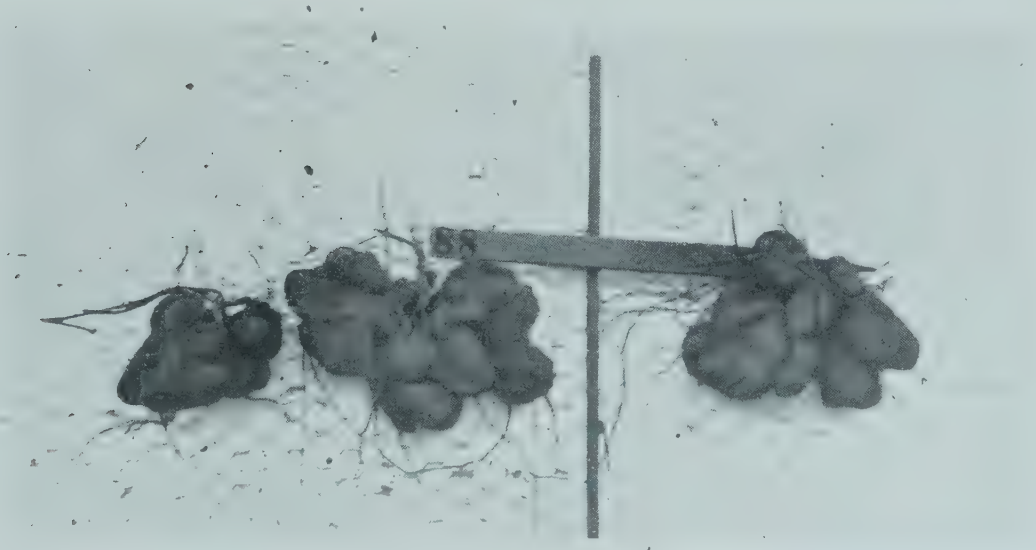
98	Saigon, "Khoai Siam"	9	7-10	3459	7.66
20	Philippine Is. 1031	5	16-15	7569	17.00
60	do. 330	4	5-5	1956	5.34
42	do. 947	8	4-2	1871	4.14
40	do. 940	9	10-9	4791	10.61
58	do. 329	21	5-2	2325	5.15
78	do. 938	4	8-11	3941	8.73
50	do. 824	6	13-9	6152	13.62
44	do. 1025	7	14-13	6719	14.88

LOBULAR, RATHER THAN FINGERED.

88	Philippine Is. 1941	4	5-14	2665	5.90
56	do. 963	9	5-6	2458	5.40
146	Fiji, 20695	4	6-6	2892	6.40
62	Philippine Is. 1023	6	10-1	4564	10.11

Yam No. 170: origin Port Darwin, Australia: flesh white with magenta sap under the skin: yams branch high up, but not from the very top.

Yam No. 98. origin Saigon, where it is known as Khoai Siam: flesh white with a little magenta sap under the skin: yams branch, but not always high up.



Yam No. 88: origin, Philippine Islands: flesh with some magenta sap at all depths: yams lobular and flattened.

Race No. 126, gave very similar tubers and its average return was only 2 lbs. 7 oz. (1103 grammes) or per acre nearly 2 tons 9 cwt. It differed from No. 26 in possessing a little magenta sap through the firm flesh. Unfortunately it is not known exactly what its origin was, but it came either from the plains of Sylhet or the adjoining parts of the Khasia Hills.

Race No. 48 from the Philippine islands which returned on the average 4 lbs. 2 oz. (1871 grammes) per plant, produces tubers differing from the last in no way except the entire absence of magenta sap. The yield per acre at the result obtained would be nearly 4 tons 3 cwt.

In minor characters the races possessing these small neat rounded tubers differ somewhat among themselves, *e.g.* No. 26 possesses prickles on its stem; but not so any of the others. All have similarly shaped leaves, but in this respect still differ a little. And all are inclined to be early ripening.

Excellence for the table would seem to be connected with grudging production.

SHORT BRANCHED YAMS.

Yam No. 170 from Port Darwin in Tropical Australia is figured at the top of plate 4. The tubers as there seen, branch at a short distance down in the soil, these branches being inseparable without breaking a considerable thickness of tissue. Thirteen plants of it were grown, the sets when planted weighing 6 lbs., and gave a return of 92 lbs. 13 oz., or on the average 15½ lbs. from every 1 lb. planted.

The flesh of the yams is white, with magenta sap in the tissue just under the skin.

The average yield was 7 lbs. 2 oz. (3232 grammes) or at the rate of rather over 7 tons 3 cwt. per acre.

Quite a number of other similar races have been grown: and it would seem as if there is something advantageous about them which makes them favoured in certain regions. It well may be that by branching their yield is increased without the demanding of deep soil, or deep cultivation. In the Philippine islands for instance their place seems to be important: and of the races now to be enumerated those bearing the numbers 20, 22, 44, 58, 64 and 78 came thence. Races No. 98 and 174 came from Saigon. The first of these two Saigon races is also figured on plate 4.

The characters and yield of the races just enumerated will now be given seriatim.

Race No. 20 from the Philippine islands has white flesh with a layer of magenta-coloured tissue just under the skin: and externally it is rather freely covered with rootlets. The average yield was good being 16 lbs. 11 oz. (7569 grammes) which is a return at the rate of 16 tons 15 cwt. per acre.

Race No. 22 has tubers almost identical with those of No. 20 in respect of skin and colour. One of them was figured on p. 299 as figure No. 8. The average yield was 17 lbs. 1 oz. (7738 grammes) which is a return at the rate of nearly 17 tons 3 cwt. per acre.

Race No. 44, has white flesh with a little magenta sap in the layer just under the skin, and in this is like the two last: but its surface is rather free from the rootiness which marks them. Its average yield was 14 lbs. 13 oz. (6719 grammes) which is a return at the rate of nearly 14 tons 18 cwt. per acre.

Race No. 56 produces tubers with magenta sap in them at all depths. Its average yield was 5 lbs. 6 oz. (2458 grammes), which is a return at the rate of 5 tons 8 cwt. per acre.

Race No. 60 in flesh and skin is exactly as the last. Its average yield was 4 lbs. 5 oz. (1956 grammes) which is a return at the rate of 4 tons 6½ cwt. per acre.

Race No. 42 has flesh with a salmon tint, the diffused magenta which in a yellow flesh results in this colour, increasing in intensity to the skin. Its average yield was 4 lbs. 2 oz. (1871 grammes), which is a return at the rate of just under 4 tons 3 cwt. per acre.

Race No. 40 produces lobular flattened tubers, free of rootlets, with white flesh, and a layer of tissue with magenta sap under the skin. It returned on the average 10 lbs. 9 oz. (4791 grammes) or at the rate of 10 cwt. 12 cwt. per acre.

Race No. 58, has white flesh—not quite ivory white but with a faint salmon flush, and under the skin is a layer of tissue holding magenta sap. Its average yield was 5 lbs. 2 oz. (2325 grammes) or at the rate of 5 tons 3cwt. per acre.

Race No. 64 has white flesh which turns brown quickly on exposure to the air. It has no magenta sap. Its average yield was 17 lbs. 10 oz. (7995 grammes) or at the rate of 17 tons 14 cwt. per acre.

Race No. 102 from Saigon where it is known as Khoai-mo, agreed closely with No. 64 from the Philippine islands, but possessed magenta sap under the skin. It yielded one tuber weighing as much as 15 lbs. but the average return was no more than 2 lbs. 13 oz. (1276 grammes) which is a yield at the rate of 2 tons 2½ cwt. per acre.

Race No. 78 from the Philippine islands produces tubers containing magenta sap at all depths, the skin being free from rootlets. Its average return was 8 lbs. 11 oz. (3941 grammes) which is a yield at the rate of 8 tons 14½ cwt. per acre.

Race No. 98 from Saigon, known there under the name of Khoai-siam, has white flesh, sometimes with a little magenta in the deeper part of the tissues, sometimes without. Its average return was 7 lbs. 10 oz. (3459 grammes) or at the rate of just over 7 tons 13 cwt. per acre. For 1917 it is being selected into two by the presence or absence of the magenta sap in the deeper tissues.

Race No. 66 from the Philippine islands, differed a little from the majority of the yams of the short branched type in the length of the fingers. The tubers have white flesh which soon turns orange-brown by oxidation when exposed to the air,—a character which has been thought suggestive of inferiority, but the surface of the tuber is free from rootlets like the best of the yams. Its average yield was 7 lbs. 2 oz. (3232 grammes) at which rate the yield per acre would be just over 7 tons 3 cwt.

Race No. 174 from Saigon under the name of Khoai tiem, produces rather elongated tubers, the flesh flecked with magenta sap, and magenta sap in a layer under the skin. The surface carries many rootlets. The average return was 4 lbs. 10 oz. (2098 grammes) or at the rate of nearly 4 tons 13 cwt. per acre.

The yams grown under the three numbers 90, 92 and 94, originating in the island of Guam, on examination appeared to be but one race, and will be treated as such in future, under the first number. Their average return was 11 lbs. 7 oz. (5488 grammes) or at a rate of nearly 11 tons 9 cwt. per acre. The flesh is white with magenta sap under the skin: and there is a marked tendency to flattening.

Race No. 100 from Saigon under the name of Khoai noc-trang, produces tubers which are excessively flattened. The flesh is white with just a little magenta sap in it both deep and under the skin. The average return was 11 lbs. 2 oz. (5046 grammes) or at the rate of 11 tons 3½ cwt. per acre.

At the bottom of plate 4 is figured yam No. 88 which is more lobular than fingered; and is very much flattened. Its origin was in the Philippine islands, and it appears to have an exact counterpart in another Philippine yam, No. 80. Both have much magenta sap in their tissues. The first named gave a return of 5 lbs. 14 oz. (2665 grammes) per plant and the second of 5 lbs. (2258 grammes) which per acre would be respectively 5 tons 18 cwt. and just under 5 tons ½ cwt.

Race No. 140 from Fiji, was similarly lobular but not flattened. Its flesh is white, turning brown rapidly on exposure to the air; and magenta sap is entirely absent. The average return was 6 lbs. 6 oz. (2892 grammes) or at a rate of 6 tons 8 cwt. per acre.

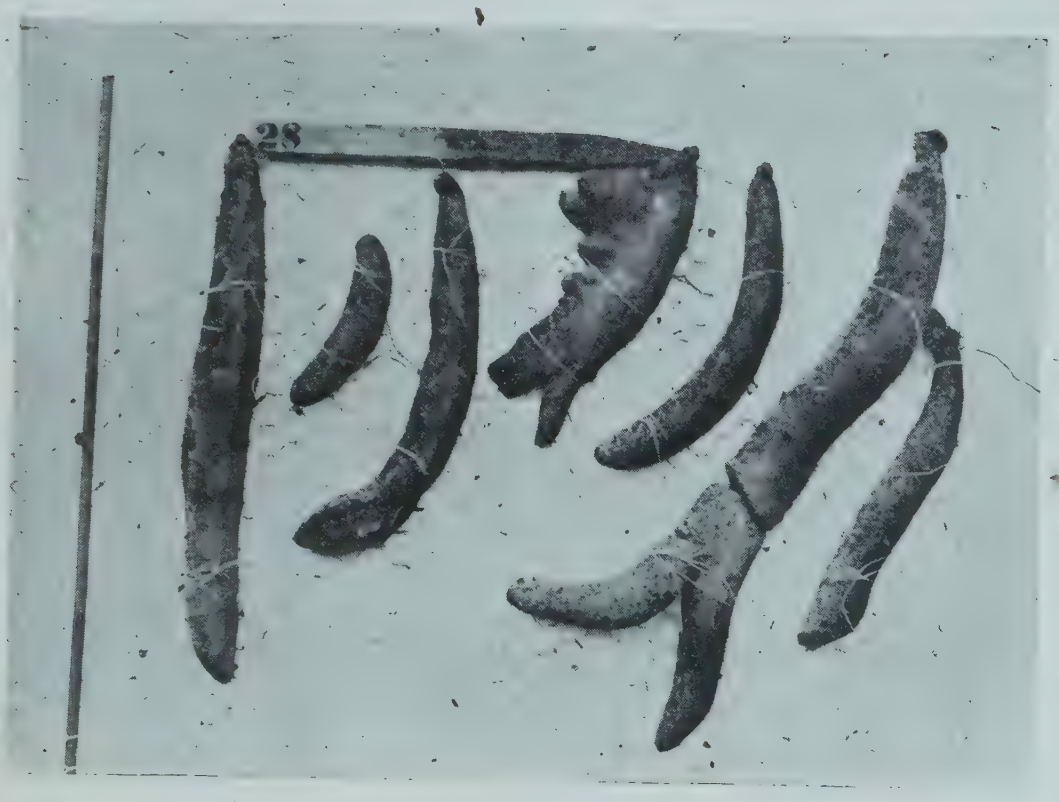
Race No. 168 from the Khasia Hills of Assam, while suggesting No. 88 in its lobular tubers, approached the half-long yams somewhat, and bore a number of uprising fleshy shoots. Its average yield was 4 lbs. 15 oz. (1240 grammes), but perhaps as yet it has not had a fair trial.

Race No. 50 from the Philippine islands gives flattened branched tubers with clean skins, and beautifully white flesh, which does not oxidise to a yellow-brown on exposure to the air. Its return was 13 lbs. 9 oz. (6152 grammes) on the average, which per acre would be almost 13 tons 12¾ cwt.

Opposite plate 5.

SLIGHTLY RECURVING YAMS.

Reg. No.	Origin	No. of plants	Average Weight lbs. oz.	grammes	Yield per acre in tons.
28	Philippine Is.	7	7-7	3374	7.47
	STRONGLY RECURVING YAMS.				
38	Philippine Is.	19	9-8	4309	9.54
32	do.	5	1-13	822	1.82
34	do.	10	3-15	1786	3.94



Yam No. 28: origin, Philippine Islands: flesh white, with magenta sap under the skin: the elongated yams curve in the soil.

Yam No. 38: origin Philippine Islands: flesh white, with magenta sap under the skin: the elongated yams change direction completely in the soil and return to the surface: subsidiary yams grow upwards.

Race No. 62 from the Philippine islands differed from all the Philippine short branched, or lobular yams in sharing with the Khasia Hills yam No. 168, the characteristic of having uprising fleshy shoots. The flesh is free from magenta sap except just under the skin, though there is just a faint salmon flush at all depths. Flattening is slightly developed. The return was 10 lbs. 1 oz. (4564 grammes) or at the rate of 10 tons 2 cwt. per acre.

In regard to foliage the series which is now under discussion varied considerably. Nos. 22, 56, 64, 66 and 98 have the auricles of the largest leaves rounded. They are all Philippine except No. 98 which is from Saigon. Quite differently shaped is the leaf of No. 146 from Fiji, for it is nearly hastate: but it does not stand geographically apart from the others because the leaves of No. 50 from the Philippine islands are somewhat similar. The leaves of all the others are of the common type. None produce prickles on the stems. The colour of the tubers varies from ivory-white to salmon and to a faint yellow tint. Obviously the combination of a delicate magenta flush with the yellow tint would produce the salmon.

If, as appears probable, yams of this short-branched type are in favour in certain regions, it will be interesting at a later date and with fuller knowledge to recognise what it is in the soil and agriculture of each favouring country which determines the choice.

PALMATE TUBER WITH A NARROW ELONGATED NECK.

Race No. 74 from the Philippine islands, produces tubers which may be considered as a development of the short branched condition. The flattening is considerable: the fingers are all or nearly all in the same plane; and because there is a kind of neck above, the whole is exactly hand-like. The flesh of the tuber of race No. 74 is white and the surface is rooty. The return was at the average 5 lbs. 13 oz. (2640 grammes) or per acre 5 tons 16¼ cwt. The foliage is of the type with broad rounded auricles; and the stem bears no prickles.

YAMS WHICH DO NOT SEND THEIR TUBERS DOWN STRAIGHT INTO THE SOIL.

To the scientist the most interesting of all the races of Yam grown are those which do not bury their tubers deeply, but have them recurving or in some cases growing upwards from their very origin. Assuredly as said above, these races owe their existence to the protection by man: also as suggested above little civilised man possibly found them excellently suitable for planting in the midden by his hut, where as the tubers extruded he would throw just a little earth and a little more refuse on to the top of them. Rumphius became acquainted with this type of yam and in the Herbarium Amboinense devoted the ninth chapter of his ninth book to a description of it, in two forms, the Ubium anguinum or Ubi

Opposite plate 6.

STRONGLY RECURVING YAMS.

See opposite plate 5.

ASCENDING AND RECURVING YAMS.

No. and Origin		No. of plants	Average Weight lbs. oz.	grammes
72	Philippine Is.	20	6-13	3090

Yam No. 38, unearthed in situ, each tuber kept in position by strings
(see plates for particulars.)

Yam No. 72: origin Philippine Islands: unearthed in situ: flesh white with magenta sap under the skin: yams ascend and then curve over.

Ular (Snake yam) and the Ubium Draconum or Ubi Boaya (Crocodile yam). He tells us that he grew them in rich clay soil free of all stones in order to demonstrate to himself that it was not obstacles in the soil which produced the unusual direction, and "many of them thrust their tails out of the soil."

The cork-screw appearance which Rumphius caused to be drawn, happens to be in excess of anything produced in Singapore, where the longer were gently sinuous.

Tamil gardeners in Singapore, were in charge of the yam beds, and when the yams, as Rumphius expresses it, thrust their tails out of the soil, these men having never seen anything similar in India, were at a loss what to do: but by earthing up as may be seen in Plate 6, the tip was covered whenever it extruded, and its elongation maintained. Experience in 1914 and 1915 had shown that if not earthed up the apex dies.

On plate 6 the reader will find figured the two most striking of the races of this type which were grown. In preparation for the figures there given, a rough bamboo scaffolding was made above the beds and to cross poles the tubers were tied by strings before the earth was removed from around them; and by this means the tubers were retained in their natural position. The race of yam shown in the upper block of plate 6 is shown again in plate 5, lower block: and the upper block of plate 5 exhibits a transition stage between what is usual and this peculiar development wherein the yams curve in the soil but not so as to extrude. Although the extreme conditions such as are shown on plate 6 appear to be confined to eastern Malaya, the condition seen in the upper block of Plate 5 is rather widely distributed: and being for instance a mark of the "Bull's horn yam" of the Shans.

The races with upgrowing tubers will now be taken seriatim commencing with the one which forms the transition.

Race No. 28 has already been figured in this Bulletin as No. 1 on page 301 from a tuber grown in 1914. In 1915 it showed a tendency to branch, but it had bad soil. In 1916 it produced yams as figured on plate 5. The flesh is white but there is magenta sap just under the skin. The skin is not rooty. The average return was 7 lbs. 7 oz. (3374 grammes) which is per acre 7 tons 9½ cwt.

This is the last yam for which a rate per acre can be given, as the others need to the cultivated further apart that they may be earthed up easily; and the number of hills to an acre would thus be reduced below 2250.

Race No. 38 is that which is shown in two plates, both plate 5 and plate 6. From plate 5 the slightly sinuous curving of the tubers may be realised: but it happened to be greater in one tuber too elongated for conveniently arranging in that group. It will be observed that in this race the direction of the tuber at first has been downwards but that at a very early stage a strong curve takes place by which the point begins to ascend more or less vertically. The age at which this change of direction comes in varies, and in one of the tubers figured the tuber did not grow down at all

before ascending. The secondary tubers produced later all ascended. The surface of these tubers is rather rooty: the flesh is white but there is a very distinct layer with magenta sap under the skin. The average yield in 1916 was 9 lbs. 8 oz. (4309 grammes).

Race No. 34 possesses the same habit of turning upwards but instead of producing one long tuber and a few much shorter secondary tubers, it produces several similar tubers which do not attain any great length. It was figured on p. 301 of the Bulletin under the No. 4. It yielded on the average 3 lbs. 15 oz. (1786 grammes) in 1916.

The bottom figure of plate 6 represents race No. 72 which behaved in a different way to the others, in that it grew upwards first and then obliquely downwards or else horizontally as is there shown. Its flesh is white, but with a distinct layer holding magenta sap under the skin: its skin is rather rooty. The average yield in 1916 was 6 lbs. 13 oz. (3100 grammes).

Plate 6 shows the yam beds, and in the lower block the supports of wood which had to be used to build up the mounds for the earthing of Nos. 38 and 72. The yams it will be observed are allowed poles to grow over about eight or nine feet high.

There is some diversity in the leaf characters of these upgrowing yams; for Nos. 28, 34 and 38 have the auricles of the largest leaves rounded; but the others have them more or less subacute. None have thorny stems.

I. H. Burkill.

THE LESSER YAM,—DIOSCOREA ESCULENTA.*

The lesser Yam, here illustrated by three plates, is quite unlike the Greater Yam in foliage, and in the production of many relatively small tubers. Economically it is less important: it is less widely known, less extensively grown, and has not been carried across oceans to the remote islands and continents which the Greater Yam has reached. Fiji for instance, seems to be its eastward limit, whereas the Greater Yam has been taken to the easternmost islands of the Pacific; and Mauritius seems to be its western limit, whereas the Greater Yam has reached Africa and has been carried also to the Tropics of the New World.

As far as can be guessed, its domestication had beginnings not less remote than the Greater Yam's, or perhaps even more remote: for the seed-forming habit has been eliminated from it quite as much as from the Sugar-cane and the Pineapple; it has for instance, never been known to fruit, which the Greater Yam does at rather rare intervals. Moreover its parentage is much more obscure than that of the Greater Yam.

Oncus esculentus, Loureiro: *Dioscorea aculeata*, Linnaens in 1754, but not in 1753: *D. fasciculata*, Roxburgh.

The Lesser Yam. No. 290, a race from Saigon known as Khoai Chach. No. 276, a race from the Philippine Islands.

No. 292, race from Saigon, grown under the name of Tu-cu. No. 288, a race from Saigon known as Khoai Tu-Bua.

Not only does it not fruit, but the production of female flowers is very rare, and the production of male flowers is apparently only common in one known race.

The three plates illustrate some of its races, in particular showing how they are to be distinguished from each other by their tubers.

In the upper block of Plate 7 is shown the Saigon race, Khoai chanh, cultivated experimentally in the Botanic Gardens, Singapore, under the Garden's number 290, and below it is shown a race from the Province of Bataan, in the island of Luzon, which bears the Gardens' number 276 and was received without a vernacular name. Again in the lower block of the same plate, in its upper row, with the Gardens' number 292, is a second Saigon race received under the name of Tu-ĉu. It will be observed at a glance that the three numbers 290, 276 and 292, have in common neat cylindrical tubers in closely packed bunches. They, however, are not identical, No. 276 from the Philippine islands having a bitter taste, not developed in the Saigon races; and the two Saigon races being distinct in some slight morphological characters, as well as in the first being a more palatable vegetable than the second.

The Philippine race is that of which one tuber was figured on p. 393 of the Bulletin, fig. 2, and again in the Philippine Agriculturist and Forester iii. 1915, p. 207 fig. 2.

All the three races produce spinous roots: but it seems that the spines in the Philippine race are larger than in the two Saigon races.

The lowest line of figures on plate 7 represents the Saigon race Khoai bua (No. 288), and the lower block of plate 8 the Assamese race Moa alu, (No. 286) both having lobed tubers. The name "Moa alu" which means "Sweet tuber" is of Sanskritic origin. It is well applied for the tubers are distinctly sweet.

Other races with lobed tubers have been or are being cultivated. Thus No. 274 of the Gardens' plots which gave figure 1 on p. 393 of this Bulletin and figure 4 on page 207 of the Philippine Agriculturist and Forester, has lobed tubers. It is of Philippine origin, having been received from the Province of La Union in Luzon. And a race with lobed tubers has been grown which came from Lower Burma under the name of Tah-dwe-u or "Letter-d yam." The distribution therefore of lobed races is at any rate more or less continuous from Assam to the Philippine islands via Burma and Saigon. But it is yet to be ascertained to what degree there are distinct races over this area: if, for instance, all are sweet like the Assamese Moa alu, etc. In regard to the name Moa alu, which is used along side that of China alu for another race, it is uncertain whether it originates in a contrasting of the sweet Moa alu with the race China alu, or in a contrasting of Dioscorea esculenta with other yams such as the Greater Yam which is never markedly sweet to the taste like Moa alu.

The number of tubers on a plant of Khoai bua is less than on a plant of one of the three races first named, viz. 290, 276 and 292, and at the same time they are individually larger. Moa alu again has fewer and larger tubers than Khoai bua: of them one for instance

in the small crop raised in 1916, attained the weight of 3 lbs. 5 oz. (1502 grammes). The irregularity of the tubers may be considered as imperfect branching: but no branching of the slender part, the stalk-like part, of the tuberous root occurs,—only of the swollen apical part.

On the upper part of Plate 8 are figures of three Indian races, which in 1916 had their growth interfered with; as a consequence of which the roots appear comparatively poor: but the habit is nevertheless truly represented. The uppermost of the three is a Chittagong race, received from India in 1913 under the name of Pora alu or "Oar tuber." In its first year in Singapore it returned so heavily from a small bed as to yield at the rate of 21,851 lbs. per acre, the number of tubers on a plant being on the average twenty-five (vide this Bulletin, pp. 302-303.) The race has roots armed freely with rather small thorns.

Under Pora alu on plate 8 are represented, as No. 296, the Goradu of Berar, and, as No. 298, the China alu of Jorhat in Assam. This latter goes unarmed or almost so: but Goradu has long formidable thorns on its protective roots, which overlie the tuberous roots. In these three Indian races the length of the tuber bears a fairly constant relation to the diameter. Their tubers are shorter and rounder than those of the trio 290, 276 and 292.

The rest of the races to be referred to, may be arranged conveniently in a series commencing with those whose tubers are relatively small and ending with those that are the largest. No. 278 figured at the top of plate 9 leads thus to No. 280 which is figured below it. Both came from the Philippine islands, the No. 278 from Tarlac under the name of Tugui, and No. 280 from the island of Palawan under the name of Invod. In both races there are formidable spiny roots and in both the flavour of the tubers is slightly bitter.

The lowest block on plate 9, represents the most distinct of all the races, a plant which produces the biggest tubers of all and bears them very diffusely: moreover it is the race which freely produces male flowers.

It occurs in the Philippine islands, whence it has been obtained and grown from four localities, *e.g.*

No. 272 Luzon, but the exact locality unrecorded.

No. 282 from cultivation in the Province of Batangas, where it is called Tugui

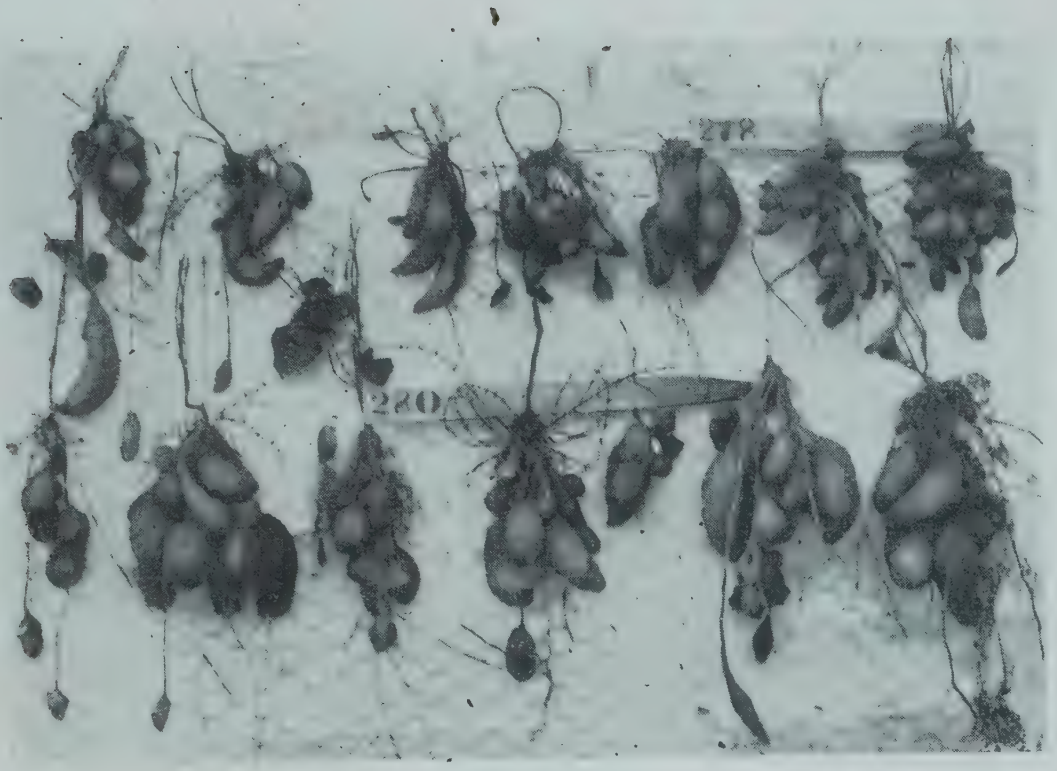
No. 270 from cultivation in the Province of Pangasinan, where it is called Carat

No. 284 from the Mountain Province, where it occurs wild, and is called Buga.

The large characteristic tubers have attained in the Singapore plots the weight of 5 lbs. 6 oz. (2438 grammes), and the longest stalk of any one measured was just over a metre in length. The tubers are densely covered with short rootlets. At the base of the stem may be found very formidably armed spiny roots but they in no way cover the diffuse tubers which lie far beyond their protection. And what is interesting about these tubers is that they may be formed quite close to the surface of the soil as if inviting the attack of pigs.

Three Indian races. No. 300, grown under the name of Pora alu, origin Chittagong. No. 298, China alu from Jorhat in Assam. No. 296, Goradu from Berar.

No. 286. Moa alu from Jorhat in Assam.



No. 278, A Philippine race grown under the name of Tuqui, origin Tarlac in the Island of Luzon. No. 280, a race from the Island of Palawan, called there Invod.

No. 284, A peculiar race of the Philippine Islands, where it seems to be common, and to occur wild (? run wild) as well as in cultivation. It has large diffusely placed tubers.

The tubers with the longest stalks are those formed latest in the season.

It might be claimed for this race that its free flowering suggests a primitive type; and in support be adduced that it is recorded above as wild in the Mountain Province of Luzon. Further it might be said that it appears to be somewhat extensively wild as male flowers may be found in herbaria on specimens from various localities in the Philippine islands which appear quite likely to be of this race and are not recorded as cultivated plants. But *Dioscorea esculenta* certainly persists in India for awhile on the sites of abandoned cultivation: and this particular Philippine race of it by reason of its diffuse tubers is the one of all most likely to be left behind in the soil when the land is abandoned to revert to jungle, under which view doubts at once arise as to the validity of any argument from its occurrence in an uncultivated condition that it is indigenous in Luzon: and then again its remarkable peculiarity that the purpose of the protective spiny roots is not fulfilled by reason of the spreading of the tubers beyond them suggests that it is not primitive. We are consequently left in as much uncertainty as regards the original home of the plant as we were: and are in need of new light.

I. H. Burkill.

GERMINATION OF THE SEEDS OF ERYTHRINA BEFORE FALLING.

In the very wet weather that occurred in Singapore unseasonably through February, and March, 1917, the seeds of *Erythrina lithosperma* in Tanglin germinated while attached to the open legume-walls still hanging on the tree.

SCOLIA ERRATICA, Smith, A PARASITE OF THE RED-COCONUT-WEEVIL (RHYNCHOPHORUS FERRUGINEUS).

Near Bemban, Malacca, on November 28th, 1916, in the course of an inspection of Coconut palms for the Red Weevil and the Black Rhinoceros beetle, two pupating parasites were obtained from within pupa cases of the Weevil: and these having hatched out on November 28th in a breeding cage, were determined by Dr. R. Hanitsch as *Scolia erratica*, Smith.

Professor Maxwell Lefroy in his Indian Insect Life (Calcutta, 1909) p. 183 says of the Scoliidae, to which it belongs, "as to the habits of this family in India, as a whole they are probably parasitic upon the larvae of Coleoptera in the soil; they persistently fly over the soil, but none have been reared; Froggatt (Agric. Gazette, N. S. Wales, 1902) records *Dielis formosa*, Guen., as an enemy of the beetle *Xylotrupes australicus*, Thoms.,* in Queensland; the wasp burrows down to the grub in the soil, stings and

*The species of Xylotrupes are Rhinoceros beetles allied to the Black Coconut beetle.

paralises it, lays an egg on it and goes away; the larva on hatching devours the grub and pupates there." The proceeding of the *Scolia* is assuredly similar, the wasp pushing a way through the broken up tissue of the Coconut stem to reach the beetle grub: but the act has not been observed.

Bingham in the Fauna of British India, Hymenoptera i. (London, 1897), p. 78, ascribes to *Scolia erratica* a distribution through the following countries, which all have a considerable rainfall,—Sikkim, Burma, Tenasserim, Sumatra and Java. Dr. Hanitsch has taken the insect at Changi, Singapore.

None of these countries are outside the range of the Red Weevil, which occurs over a much wider area, and into much drier regions—even for instance to the Suleiman range on the border of Afghanistan (Ghosh in Memoirs Dept. Agric. India ii No. 10 p. 206). The distribution, therefore, does not suggest another host for the parasite: but we have no warrant for saying that it preys exclusively on the Weevil grubs. Observations should be made.

Scolia erratica, at any rate, may be counted as a beneficial insect.

I. H. Burkill.

THE FLOWERING OF THE PIGEON ORCHID. DENDROBIUM CRUMENATUM, Lindl.

There is a paper of considerable interest by Drs. A. A. L. Rutgers and F. A. F. C. Went on the flowering of the Pigeon Orchid in the last issue of the Annals of the Botanic Garden, Buitenzorg,* in which observations are set forth to throw light upon the marked synchronised flowering of this common plant. The one author worked in Java; the other in Holland: in Java the plants under experiment were grown in the Botanic Garden at Buitenzorg, and observations made there were supplemented by others made elsewhere in the island; in Holland the plants under experiment were grown under glass in the Utrecht Botanic Garden, having been sent thither from Java, and the observations made there were supplemented by others made in Bonn, Gottingen and Hamburg.

In Utrecht the plants maintained their habit of flowering all together, but the dates were different, and the frequency less, because through the winter they did not flower: moreover although at first they bloomed and faded on one and the same day, after the cultivation had gone on for some time they commenced to occupy two days with their flowering because the buds did not open all together on the first day.

On p. 133 a table is given which shows that at Buitenzorg in the year 1894 there were eleven flowerings, in 1895 eight, in 1896 seven, in 1912 ten; but at Utrecht there were four flowerings in 1913, six in 1914 and six in 1915.

*Annales du Jardin Botanique de Buitenzorg, xxix (1916) pp. 129-160.

The authors point out at what irregular intervals the flowering occurs: and they call attention to the way in which the dates differ from place to place, as for instance March the first may be the day for flowers in one spot, but thirty miles away the day for flowers may be March the fourth. The authors then draw the deduction that flowering has not a fixed period, but depends on external circumstances, which circumstances have to be identified.

For the purpose of their work a large number of plants were fixed in positions in the Buitenzorg Gardens where they obtained very different amounts of light: those that got the least then flowered the less freely, but they nevertheless flowered on the same days as their more favoured neighbours. The sums of the light and direct heat of the sun, therefore, are not the controlling factors for the opening of the flowers: they act only upon the vigour of the plants.

Plants in the Utrecht Gardens did not flower through the winter, over which the temperature in the plant houses was controlled by artificial heat within narrow limits: but when spring brought bright weather and the sun shone strongly on the glass roofs it was impossible to keep the temperature any longer from rising far above its former limit, and then in three weeks the plants burst into flower, not only at Utrecht, but at Hamburg and Bonn, the bright spell spreading over all three places, as if the rise in temperature or quite possibly the greater fluctuations had given the required stimulus.

Further the authors do not go than to make a suggestion that this is so and to add that very probably moisture also has an influence: because the flowering takes place so irregularly they suggest that it is possible that the two work together.

If a Pigeon Orchid plant be examined it will be seen that the flowers are produced from large persistent scaly buds. The authors compare these buds to the winterbuds of European trees, calling attention to the circumstance that winter buds are formed in the autumn to pass through a period of rest until spring brings a stimulus for renewal of growth: and they bring forward observations to show that a period of retarded growth occurs in the maturing of the flowers in the Orchid followed by extremely rapid growth at the end, the flower buds rushing to the expanding. During this time of slow growth many buds may fail: the others arrive at a certain stage and wait: the longer the requisite stimulus is in coming the more buds should there be all brought together to the same stage, and the more abundant should be the flowering when it comes, only there is this death of buds to interfere with the process. When the stimulus comes all the buds which have reached the stage of arrest find themselves driven forward together to the flowering, and so it is synchronised.

It is evident that much remains yet to be ascertained before we have a complete understanding of the phenomenon: but the hypothesis which Drs. Rutgers and Went put forward appears to offer a point of vantage from which new experiments may be directed, and may be examined briefly in regard to observations made in Singapore.

RAINFALL in hundredths of an inch over periods of 30 days leading up to flowering of Dendrobium crumenatum.
t. means a trace

Sparingly	?	?	?	t	...	..	...	..	...	...	...	...	...	...	...	1	...	...	15	36	48	181	662	425	7	62	...	2	55	94	...	Mar. 12, 1913.
Abundantly	46	t	...	...	26	7	46	1	37	209	t	...	...	7	31	t	17	...	...	37	5	...	...	58	...	27	2	114	4	47	1	June 6
Freely	325	t	...	...	1	...	24	t	7	...	...	64	30	t	27	...	14	...	8	...	...	...	...	43	...	...	4	2	...	...	7	Aug. 2
2 plants only in same spot	7	...	...	64	30	..	27	...	14	...	8	...	...	...	..	43	...	...	4	2	...	...	7	...	...	...	...	..	17	...	82	Sept. 6
2 plants only in a different spot	2	..	...	7	...	...	...	...	...	17	..	582	102	103	20	...	40	78	76	...	...	33	71	2	30	...	3	32	3	6	72	Sept. 25
	...	6	t	...	...	..	3	58	3	96	27	21	76	...	176	127	22	6	...	81	140	41	20	3	2	195	37	7	84	32	t	Nov. 6
Abundantly	6	...	81	140	41	20	3	2	195	37	7	84	32	t	t	...	130	62	29	21	173	2	125	21	147	7	24	183	t	..	23	Nov. 23
	...	1	..		18	t	...	...	123	...	3	254	168	...	t	111	273	52	97	27	1	33	123	1	37	186	5	114	2	1	7	Feb. 8, 1914.
Abundantly	2	1	38	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	22	5	131	...	...	...	52	t	1	...	Mar. 13
	4	...	t	258	...	2	...	...	...	162	2	...	10	..	1	25	40	2	1	5	62	232	t	20	...	79	t	...	..	...	3	May 15
	...	...	...	..	31	27	6	94	5	211	1	18	10	14	...	...	65	4	...	...	...	...	246	1	26	24	16	48	16	105	...	July 4
Sparingly	...	...	...	...	..	...	...	...	..	3	...	...	4	147	17	37	28	...	3	...	..	...	32	2	38	2	1	...	...	...	...	Sept. 24
One plant only	89	172	2	17	62	5	...	t	28	t	2	...	...	309	56	t	12	23	...	43	2	..	3	...	102	147	8	2	3	41	14	Dec. 25
Few flowers only	172	2	27	62	5	...	...	28	..	2	...	...	309	56	...	12	23	...	43	2	...	3	...	102	147	8	2	3	41	14	12	Dec. 26
Sparingly	2	27	62	5	..	...	28	..	2	...	...	309	56	...	12	23	...	43	2	...	3	...	102	147	8	2	3	41	14	12	58	Dec. 27

Freely	58	1	2	72	14	...	...	80	26	69	35	11	45	21	121	23	...	t	...	t	6	7	5	113	1	21	10	9	...	27	10	Jan. 26th, 1915.
	98	61	4	...	...	...	..	...	...	...	23	...	...	...	...	19	..	...	...	10	...	...	48	t	27	5	56	14	...	.	24	Mar. 20th,
	...	24	11	17	28	...	32	4	72	...	—	1	1	1	...	134	...	4	...	t	...	3	30	80	...	51	41	t	14	t	14	April 18th,
	20	...	100	7	...	1	1	...	...	t	...	...	...	75	7	...	...	73	3	1	32	...	174	t	...	t	26	32	t	5	68	July 2nd,
Very abundantly	4	58	1	21	1	19	t	25	...	...	..	...	2	74	22	94	181	70	84	3	...	1	..	...	2	171	19	...	48	4	3	Sept. 18th.
Freely .	20	...	...	t	...	t	128	138	5	173	1	84	15	8	102	15	25	126	...	32	t	...	38	16	t	9	24	105	1	..	t	Nov. 28th,
Freely	...	t	9	8	19	3	...	...	...	..	...	...	...	...	...	...	...	...	...	...	...	...	106	...	...	...	...	...	...	...	...	Feb. 19th, 1916.
Abundantly	64	t	..	10	14	1	64	46	101	65	35	1	136	...	...	...	...	...	.	...	.	...	52	9	18	..	2	18	t	24	23	April 20th,
	7	60	223	...	3	3	4	...	1	...	...	...	19	..	....	21	7	...	69	1	3	t	5	88	25	57	35	...	108	54	...	June 13th,
Sparingly	...	..	27	19	374	..	...	...	34	...	115	1	45	6	...	285	6	7	...	49	60	...	153	...	61	6	2	36	4	5	14	Sept. 6th,
Rather abundantly	...	...	...	32	...	14	...	65	...	...	...	t	135	1	2	1	68	9	19	t	7	33	213	7	...	...	...	66	...	...	.	Oct. 12th,
Freely	34	...	10	7	2	234	45	5	2	...	9	78	171	1	23	1	...	5	65	1	23	...	106	322	272	84	6	217	25	55	48	Jan. 17th, 191
Very sparingly	...	10	7	2	234	45	5	2	...	9	76	171	1	23	1	...	5	65	1	23	...	106	322	272	84	6	217	25	55	48	16	Jan. 18th,
Rather freely	10	7	2	234	45	5	2	...	9	78	171	1	23	1	...	5	65	1	23	...	106	322	272	84	6	217	25	55	48	16	51	Jan. 19th,
Very sparingly	7	2	234	45	5	2	...	9	78	171	1	23	1	...	5	65	1	23	...	106	322	272	84	6	217	25	55	48	16	51	1	Jan. 20th,
Sum of rainfall	967	432	840	1027	953	388	418	557	742	1322	717	1203	1391	846	623	1082	1022	653	542	480	988	1291	2920	1953	1258	1391	624	1225	558	642	551	

During the last four years in the Botanic Gardens, Singapore, the flowering of the Pigeon Orchid occurred on the following dates:—

	1913.	1914.	1915.	1916.
January	—	—	26th (freely)	—
February	21st	8th	—	19th (freely)
March	12th. (sparingly)	13th (abundantly)	20th	—
April	—	—	18th	20th (abundantly)
May	—	15th	—	—
June	6th (abundantly)	—	—	13th
July	—	4th	2nd	—
August	29th (freely)	—	—	—
September	6th (grudgingly) 25th (grudgingly)	24th (sparingly)	18th (very abundantly)	6th (sparingly)
October	—	—	—	12th (rather abundantly)
November	6th 23rd (grudgingly)	—	28th (freely)	—
December	—	25th, 26th and 27th (sparingly)	—	—

There are twenty-seven dates in all in the four years: and since the commencement of 1917 another flowering extending over four days has taken place. On either the seventh, eighth or ninth day before each flowering there was heavy rain, except before the dates September 6th, 1913, November 6th, 1913, May 15th, 1914 and September 18th, 1915. But ten days before the flowering of May 15th, 1914 there was heavy rain, and eleven days before the flowering of November 6th, 1913 there was also heavy rain. However, before the flowering of September 18th, 1915, which was a very abundant one, there was no heavy rain between the sixth day and on the fifteenth day, but rainless days about the eighth: and before September 6th, 1913, when two plants only flowered, there was very little rain after the sixteenth day until the eve of the flowering.

Therefore, although the rainfall statistics read in the Botanic Garden lend some support to the explanation suggested by Drs. Rutgers and Went, in that they suggest as possible that climatic conditions some eight days in advance of the flowering are a controlling factor, reservations must be made: and more observations are called for.

It is not probable that the volume of the rain which falls exercises any direct influence on the flower buds: but it is quite probable that the changes in temperature accompanying heavy rainfall,—a lowering produced by the exclusion through clouds of some of the heat of the sun, by down draughts of cold air, and by the temperature of the air against the sodden soil as the rain evaporates. determine the occurrence. Unfortunately no adequate record of the temperature in the Botanic Gardens is available for use and no mere record of maxima and minima is likely to be fully sufficient, as the phenomenon probably depends on temperature changes, and not on absolute temperatures.

It will be remembered that in the last issue of this Bulletin a short series of observations on the dates of flowering of the minute orchid, *Taeniophyllum serrula,* was given. In comparing that with the local rainfall, it is seen that the fourth day before each flowering was in most cases one with little or no rain: but this was not without exceptions.

I. H. Burkill.

PRECOCIOUS FLOWERING OF MELIA.

Recently the writer were shown by Mrs. G. P. Owen, in Singapore, many seedlings of *Melia azedarach,* Linn., the Persian lilac, flowering at two inches in height: and the occurrence leads up to the remark that there are more trees than one in its order—the Meliaceæ—which may behave in this unusual way. Costerus in the Recueil des travaux botaniques Néerlandais, i. p. 128 has recorded the precocious flowering at two inches in height of *Melia arguta.*

Hemsley in Hooker's Icones Plantarum, plate 2786 (1905) figured a mahogany plant (*Swietenia Mahogani,* Jacq.), one of many which flowered in Trinidad, West Indies, at the height of 6 to 10 inches. Since then the Mahogany has flowered in a similar premature way in India (Rama Rao, in Indian Forester, 1913 p. 327).

I. H. Burkill.

RAINFALL at the Director's house, Botanic Gardens, Singapore, during the first half year, 1916.

Readings taken always at 8 a.m. and credited to the date in which the twenty-four hours began.

No. of Date.	Jan.	Feb.	Mar.	Apr.	May.	June.
1	.16	..	1.07	1.36	.12	.01
2	1.38	..	.19	..	.07	.03
3	.07	..	.05	..	.05	trace
4	.46	..	..	..	..	.05
5	.12	..	..	..	..	.88
6	.07	..	.01	..	.67	.26
7	..	..	2.24	..	..	.57
8	.02	..	trace	..	.63	.35
9	..	..	.03	..	..	..
10	..	1.06	.55	..	1.03	1.08
11	.43	trace	trace	.52	.03	.54
12	trace	..	.43	.09	..	..
13	.56	..	.71	.18	.07	.25
14	.08	..	.09	..	.60	.15
15	.05	..	.07	.02	2.23	.07
16	trace	..	.08	.18	..	.85
17	..	..	.57	trace	.03	.43
18	..	..	1.19	.24	.03	..
19	..	..	..	.33	.04	..
20	trace	..	.64	trace	..	..
21	.09	..	trace	..	.01	..
22	.08	..	..	.31	..	..
23	.19	..	.10	..	..	..
24	.03	..	.14	.31	..	.49
25	..	..	.01	.20	.19	trace
26	..	.01	.64	..	..	..
27	..	.01	.46	.69	..	.12
28	..	..	1.01	trace	.21	..
29	..		.65	..	.07	..
30	..		.35	..	..	.01
31	..		.01		.69	
	3.79	1.08	11.29	4.43	6.77	6.14

RAINFALL at the Director's house, Botanic Gardens, Singapore, during the second half year, 1916.

Readings taken always at 8 a.m. and credited to the date in which the twenty-four hours began.

No. of Date.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	.98	.17	.02	.07	trace	trace
2	.03	.03	.36	.33	.01	.22
3	.84	..	.04	2.13	..	trace
4	.01	.01	.05	.07	..	.03
5	.18	..	.14	..	..	..
6	.20	..	.05	..	..	..
7	..	..	.34	..	trace	.28
8	..	.27	trace	.66	.28	.03
9	.01	.19	..	..	2.11	.29
10	.27	3.74	.34	..	.55	.03
11	.03	..	..	..	1.68	.05
12	.56	..	..	..	..	.01
13	1.38	..	..	.13	..	trace
14	.01	.34	.32	.20	.01	..
15	..	..	..	.68	..	..
16	.68	1.15	.14	.32	.02	.01
17	..	.01	..	.50	.32	.34
18	.02	.45	.65	.05	.84	..
19	.04	.06	..	.22	1.01	.10
20	.64	..	..	trace	1.23	.07
21	.09	2.85	..	..	.25	.02
22	.70	.06	trace	.07	trace	2.34
23	.88	.07	1.35	trace	..	.45
24	.20	..	.01	.03	.09	.05
25	.01	.49	.02	..	.01	.02
26	.01	.60	.01	..	1.26	..
27	1.42	..	.68	..	.41	.09
28	.01	1.53	.09	..	.63	.78
29	..	..	.19	.18	.55	1.71
30	trace	.61	trace	.05	.23	.01
31	1.78	.06		trace		.23
	10.98	12.69	4.80	5.69	11.49	7.16

RAINFALL at the head of the Waterfall Gardens, Penang, during the first half year, 1916.

Readings taken at 8 a.m. and credited to the date in which the twenty-four hours began; the registration kindly put at the service of the Gardens by the Municipality of George Town, Penang.

Date.	Jan.	Feb.	March.	April.	May.	June.
1	..	..	.27	..	..	..
2	..	..	.77	..	1.48	..
3	..	..	..	..	..	..
4	..	..	..	..	..	.55
5	..	..	..	..	..	..
6	.17	..	.90	..	.81	..
7	.70	..	..	..	.90	..
8	1.30	..	..	.25	.37	..
9	..	..	..	..	1.00	..
10	..	..	..	1.05	1.02	.19
11	..	1.50	..	..	.17	1.17
12	..	..	..	1.44	..	..
13	..	..	.76	..	.59	..
14	..	..	.83	..	2.03	..
15	..	..	.02	..	.09	..
16	..	..	..	..	2.00	1.17
17	..	..	1.02	.70	.02	.63
18	..	..	.80	.09	..	..
19	..	..	.84	..	..	..
20	..	..	..	..	..	..
21	..	..	..	1.12	..	..
22	..	..	..	.75	.31	..
23	..	.10	1.35	.20	..	..
24	..	.07	..	.15	.87	..
25	..	2.72	.08	.17	.29	..
26	..	.08	.02	.20	.27	..
27	..	..	.80	.10	..	.55
28	..	..	..	..	.06	..
29	..		1.13	..	..	..
30	..		1.50	..	.27	.58
31	..		..		.58	
	2.17	4.47	11.09	6.22	13.13	4.84

RAINFALL at the head of the Waterfall Gardens, Penang, during the second half of the year, 1916.

Readings taken at 8 a.m. and credited to the date in which the twenty-four hours began; the registration kindly put at the service of the Gardens by the Municipality of George Town, Penang.

Date.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1	.55	.03	.12	..	..	..
2	1.06	.40	1.10	..	..	..
3	.04	..	.96	.12	..	..
4	..	..	.13	..	1.50	..
5	..	..	.21	.05	.17	..
6	..	.06	..	.54	1.37	..
7	.12	..	..	.14	..	.42
8	..	.20	..	.80	..	..
9	.58	..	..	.28	..	.05
10	.11	..	..	1.71	..	.05
11	.12	..	..	..	..	.02
12	..	..	..	.53	..	.02
13	.36	..	.19	1.31	.18	.39
14	.41	..	2.03	..	.15	..
15	1.56	..	.02	.04	..	..
16	..	..	..	1.80	.68	..
17	4.85	1.31	..	1.73	.14	..
18	4.17	..	..	3.41	..	..
19	.54	..	..	.36	..	..
20	.40	.07	..	.26	..	..
21	..	.10	..	.02	..	..
22	.12	..	..	1.37	..	..
23	.06	..	..	3.57	..	.25
24	.06	.54	.02	1.47	..	.57
25	..	.37	..	4.83	..	.45
26	.06	.08	1.10	..	.48	.18
27	..	.80	1.87	.03	..	.08
28	.30	..	.06	.14	.14	..
29	.11	.05	.08	..	.28	..
30	1.36	..	..	..	.61	..
31	2.30	..		..		..
	19.24	4.01	7.89	24.51	5.60	2.48

SUMMARY OF RAINFALL, 1916

	SINGAPORE.			PENANG.		
	No. of rainy days.	Amount of rain in inches.	Longest Spell without rain.	No. of rainy days.	Amount of rain in inches.	Longets Spell without rain.
January - -	18	3.79	16	3	2.17	33
February -	4	1.08		5	4 47	
March - -	27	11.29	2	15	11.09	6
April - -	15	4.43	9	12	6.22	8
May - -	18	6.77	3	19	13.13	4
June - -	19	6.14	6	7	4.84	9
July - -	26	10 98	2	22	19.24	3
August - -	19	12.69	3	12	4.01	8
September -	21	4.80	3	13	7.89	8
October - -	19	5.69	4	22	24.51	6
November -	22	11 49	4	11	5.60	8
December -	25	7.16	2	11	2.48	9
Total	233	86.31	—	152	105.65	—

Greatest amount in 24 hours. ...	3.74	4.85
,, ,, 48 ,, ...	3.93	9.02
,, ,, 72 ,, ...	4.34	9.87
Excessively rainy periods, more than 5.00 having fallen in 72 hours -	0	3 (July, Oct. 2)
No. of days when the condition eixsted	0	7
Periods of Comparative drought, less than 0.02 having fallen in 120 hours - -	8	14
No. of days over which the condition existed (Jan. 2, Feb. Apr. May, Aug.- Oct. Nov.)	39	71 (Every month except May, July and September)
Longest of the Spells - - -	16 days.	33

NEW BOOKS.

We have been asked to express publicly an opinion upon the following two books.

DE SORNAY, P., *Green Manures and Manuring in the Tropics*, —(a translation by F. W. Flattely of M. de Sornay's Les plantes tropicales alimentaires et industrielles de la famille des Legumineuses, Paris, 1913) London, John Bale, Sons and Danielsson, Ltd., 1916. Pp. xvi + 466 with copious illustrations. Price 16 shillings net with postage abroad one shilling and sixpence.

There is a great difference between the French and English, titles, and the French is by far the more expressive of the contents of the book, which is a full account of the tropical Leguminosae whether used for green manuring or for any other purpose, or whether injurious to stock, in fact all that have a direct bearing on man's operations. The translation follows the French text closely.

The book is a work of reference, and is excellent.

MUNRO, R. W. and BROWN, L. C. *A practical guide to Coconut planting*, London, Messrs. John Bale, Sons, and Danielson, Ltd., 1916, pp. xx + 186, with 103 plates. Price 7 shillings and sixpence: postage abroad ninepence.

"This book.....is the outcome of a request made by the Government of the Federated Malay States," and it is claimed by the authors as written for the "intending planter" in the Malay Peninsula. It is meant to tell what costs will be entailed and what returns may be got: and with this purpose in view, the advocacy has been placed in very experienced hands. But the book from the point of view of readers is a little difficult to class: as it is neither so detailed in regard to the first processes of cultivation that the man who has never seen land cleared can take it for a text-book, while it proceeds beyond what can be assimilated by him towards the requirements of the made planter without going far enough in describing races of the coconut palm, and its pests, as to be a vademecum on the Plantation. The existence of many races of the Coconut for instance is all but ignored.

As regards pests; the Red Weevil assuredly does not live in manure (p. 115), nor in rubbish heaps unless dropped into them with infected palm tissue. Brachartona, a moth which attacks the coconut palm leaves badly, is not suppressed in the south of the Peninsula by the ichneumon mentioned in the book, but by the fungus Botrytis necans. The caterpillar described on p. 140 without a name might be that of Erionota thrax, but no less that three different orders of Lepidoptera are represented without information on the associated plate. Helminthosporium, a fungus mentioned on p. 139 is not described at all, and the description of the mild attack of Pestalozzia is inadequate.

The agricultural advice which fills most of the book is excellent. The paramount importance of aeration of the soil has its due place: cover crops, as distinct from catch crops, are recommended, in such a way that the made planter may learn. The wealth of illustrations is excellent,

ERRATA.

p. 309 line 14 from bottom (description of *Loxura atymnus*) for *5 cm.* read *35 mm.*, and lines following for *plate xxxix figure 2,* read *plate xxiv figure 7.*

p. 309 last line (description of *Tagiades gana*) for *plate xxiv figure 7,* read *plate xxxix figure 2,* and for *9 cm. read 45 mm.*

p. 337. The line commencing Ayer Pasir is misplaced, and should be among the statements relating to the circle round Alor Gajah.

p. 343 last line for *circule* read *circle.*

p. 352 line 4, for *affected* read *effected.*

SUGGESTION FOR BINDING.

No. 1 of this volume is the index to the second series of the Agricultural Bulletin of the Straits and Federated Malay States, and should be bound with it.

No. 2 commences with page 1, and should count as the first part of the Gardens' Bulletin.

Index.

A

Abnormality in Xanthosoma, 244.
Africa, East, coconut pests in, 181.
Agave, disease of, 193.
Agricultural Bulletin, F. M. S., 126.
Akar beluru, 5.
Aleurodicus destructor, 155.
Alocasia, cultivation, 227.
Antiaris toxicaria, poison, 323.
Areca Nuts.
    Production in Malacca, 221.
    Production in Penang, 233.
    Production in Singapore, 226.
Arenga saccharifera, 221.
Arrow-head, cultivation in P. Wellesley, 228.
Artickoke, Jerusalem, as pig-feed, 8.
  „ „ cultivation, 11.

B

Bailey memorial, 122.
Betel nut, see Areca nut.
Blastophaga, 195.
Blow-pipe poison, 323.
Books reviewed:—
    on Ceara rubber, 245.
    on Coconuts, 245, 411.
    on Elaeis, 246.
    on Javanese Flora, 246.
    on Leguminous plants, 411.
    on rubber in Brazil, 329.
Botany of Malaya, 197, 310, 318, 320, 353.
Brachartona catoxantha, 207.
Botrytis necans, 208.

C

Cacao, fertilisation of, 195.
  „ grown in Singapore, 227.
Cadamustus typicus, 329.
Caesalpinia, hard seeds of, 193.
Calabar bean, 47.
Calogramma festiva, 209.
Canarium commune, composition of seeds of, 237.
Canarium rufum, composition of seeds of, 322.
Caprification in Malaya, 195.
Castor oil plant, account of, 157.
Ceara rubber, yield of, 246.
Cephaelis Ipecacuanha, 45.
Chillies, grown in Dindings, 235.
Clerome gracilis, 188.
Cloves, cultivation in Penang, 228, 233.
  „ growth in Dindings, 235.
Coca leaves, demand for, 48.
Cocaine, manufacture, 48.
Coconuts, area in Dindings, 234.
Coconuts, in Penang, 232.
  „ killed by lightning, 329.
  „ pests of, Aleurodicus, 155.
  „ „ Brachartona, 297.
  „ „ Cadamustus, 329.
  „ „ Oryctes, 177.
  „ „ Rhynchophorus, 185, 399.
  „ production in Singapore, 225.
Colletotrichum Agaves, 194.
Crinum asiaticum, pest of, 209.
Croton sparsiflorus, alien weed, 235.

D

Dendrobium crumenatum, flowering of, 400.
  „ „ variety of, 318.
Derry, R., rubber machine, 81.
Dioscorea aculeata, 227.
  „ „ races of, 302, 396.
  „ alata, races of, 297, 369.
  „ „ sprouting of, 306.
Dipladenia Harrisii, trap for insects, 325.
Drymoglossum piloselloides, 321.

E

Economic gardens, blocks of, 288.
Eleusine coracana, 235.
Entada scandens, 4.
Entomology, Bureau of Applied, 244.
Eria gracilis, variety of, 189.
Erythroxylon Coca, 48.
Eucalyptus, trials of, in Singapore, 147.
Euphorbia pulcherrima, cultivation of, 12.
Exhibitions, Brussels, 40.
  „ London, 27.
  „ New York, 33, 43, 115.
Explosives, clearing by, 160, 176.
Export prices, 13, 69, 92, 163.
Exposition, see Exhibitions.

F

Ficus nota, fertilisation of, 195.
Flowering of Orchids, 244, 400.
Fowls, trade of Penang in, 232.
Fruit cultivation in Penang, 228.
Fungi, on Agave, 193.
  „ on Brachartona, 207.

G

Gambier, in Singapore, 227.
Ginger, production in Malacca, 222.
Gogo vine, 4.
Grammatophyllum, flowering of, 244.

H

Habenaria Havillandi, described, 190.
Haemaria discolor, described, 351.
Hapaline appendiculata, described, 192.
Hevea brasiliensis, see Rubber-tree, Para, 213.
Hills, T. Hislop, 213, 253.
Hyarotis adrastus, trapped in a flower, 355.

I

Ichneumon parasite of Brachartona, 207.
Indigo cultivation, 50.
„ grown in Singapore, 224.
Indigofera tinctoria, 50.
International Congress of Tropical Agriculture, 331.
Ipecacuanha, 45.

J

Johore, Botany of, 318.

K

Kabong, 221.
Kedah, botany of, 197, 353.
Kenari seeds, composition of, 237, 322.
Kuala Kangsar, rubber in, 248, 252, 258.

L

Labour, 25, 37, 39, 108, 119, 123, 133, 140.
Lallang and locusts, 348.
Lemon grass in Singapore, 227.
Lightning killing coconuts, 329.
Locusts in Malacca, 335.
Loxura atymnus, 308.

M

Mahogany, flowering of, 405.
Mangrove bark, trade, 331.
Manihot rubber in Brazil, 330.
Manuring, green, for rice, 330.
Melia Azedarach, flowing of, 405.
Microstylis congesta, described, 319.

N

Nest of a living fern, 321.
Nutmegs, cultivation in Penang, 228, 233.
„ cultivation in Singapore, 227.

O

Ophiusa, 158.
Opuntia monacantha, 320.
Orchid notes, 189, 197, 244, 318, 349, 353, 400.
Oryctes rhinoceros, 177.

P

Pachytylus danicus, 222.
Pahang, botany of, 310.
Papua, a journey in, 57.
Penang, botany of, 353.
Pepper, production in Malacca, 222.
„ „ in Singapore, 227.
Physostigma venenosum, 47.
Pigeon orchid, flowering of, 400.
Pigs, feeding of, 8, 219, 231, 227, 228.
„ production of, in Malacca, 219.
„ „ in Penang, 231.
Pineapples, production in Singapore, 224, 227.
Pineapples, waste of canneries, 224.
Pisang batu, grown in Singapore, 227.
Plants for sale, 199, 359.
Planters' Association reports, 137, 23, 107.
Plocoglottis porphyrophylla, described, 190.
Poinsettia, cultivation of, 12.
Poisonous plants, Antiaris toxicaria, 323.
„ „ Calabar bean, 47.
„ „ Wikstroemia Ridleyi, 333.
Porphyroglottis Maxwelliae, described, 189.
Potatoes for pigs, 8.
Potato, sweet, see Sweet Potato.
Poultry, trade of Penang, 232.
Prickly pear in Singapore, 320.
Pruning, instructions for, 55.
Pycnonotus analis, 321.

Q

Quarantine station, 23, 107.

R

Ragi, cultivation of,
Rainfall in Singapore Gardens, 198, 240, 324, 356, 406.
„ in Penang Gardens, 241, 326, 357, 408.
„ see Weather.
Rhopaloblaste, pest of, 188.
Rhynchophorus ferrugineus, 185, 399.
Reviews, see Books.
Rice, cultivation in Dindings, 235.
„ „ in P. Wellesley, 228, 234.
„ „ in Malacca, 222.
Ricinus communis, 157.
Rubber, Derry's machine for, 81.
„ exports, 139.
„ factories, 5.
„ Growers' Association, 129.
„ industry in Brazil, 329.
„ market reports, 67.
Rubber-tree, Para, area in Malacca, 213.
„ „ area in Dindings, 234.
„ „ area in Penang, 229.
„ „ area in Singapore, 223.

Rubber-tree, para, chemistry of latex, 150.
„ „ growth in St. Lucia, 152.
„ „ growth in Seychelles, 153.
„ „ history of planting, 214, 247.
„ „ propagation by cuttings, 251.
„ „ size attained, 210.
„ „ seed selection, 212.
„ „ seed crops in Singapore, 293.
„ „ tapping methods, 253.
„ „ vitality of seeds, 1.
„ „ yield to tapping, 211.

S

Sagittaria sagittifolia, cultivation, 228.
St. Lucia, rubber in, 152.
Sago, trade returns of Penang, 231.
Samoa, coconut pest in, 178.
Sarcochilus stenoglottis, described, 189.
Scolia erratica, 399.
Seed, hardness of, of Caesalpinia, 193.
Seed of Hevea, vitality of, 1.
Seed selection in rubber, 212.
Setol, botany of, 197, 353.
Seychelles, Hevea in, 153.
Soap, Entada as, 4.
Sugar in latex, 150.
Sugar cane, cultivation in P. Wellesley, 228.
„ cultivation in Singapore, 227.
Sugar, Production of Kabong, in Malacca, 221.
Sweet potatoes, in Singapore, 227.
Swine, see Pigs.

T

Tachinid fly parasite, 207.
Taeniophyllum serrula, described, 352, 405.
Tagiades gana, 318.
Tan Chay Yan, 213.
Tapioca, cultivation in Malacca, 219.
„ „ in Penang, 230.
„ „ in Singapore, 224.
Tapping, effect of, on seeds, 2.
Thecostele maculata, described, 350.
„ secunda, described, 318, 349.
Theretra nessus, 308.

V

Vegetable production in Penang, 228.
„ prickly pear as, 227.

W

Weather reports, Kelantan, 18, 101, 169.
„ „ Malacca, 104, 173.
„ „ Negri Sembilan, 20, 77, 97, 168.
„ „ Pahang, 22, 73, 94, 174.
„ „ Penang, 167.
„ „ Perak, 15, 75, 96, 170.
„ „ Selangor, 17, 71, 99, 172.
See also Rainfall.
Wages in Malacca, 217, and see Labour,
Wickham rubber-curing process, 159.
Wikstroemia Ridleyi, 333.

X

Xanthosoma violaceum, described, 244.

Y

Yams, cooking of, 304.
„ greater, races of, 297, 369.
„ greater, sprouting of, 306.
„ greater, yield of, 374.
„ lesser, cultivation in P. Wellesley, 228.
„ lesser, cultivation in Singapore, 227.
„ lesser, races of, 302, 373.
„ lesser, yield of, 303.
„ pests of, 306.

The

Gardens' Bulletin

STRAITS SETTLEMENTS

Vol. VII. 10th May, 1933 Part 2.

CONTENTS.

	Page
Additions to the Flora of the Malay Peninsula, by *M. R. Henderson*, F.L.S., with plates XV—XXXII and 2 text figures	87
Index	127
Notes on Malayan Dipterocarpaceae—I, by *C. F. Symington*, B.Sc., with plates XXXIII—XLVII ..	129
Index	156
Enumeration of Malayan Ebenaceae, by *R. C. Bakhuizen van den Brink*, with plates XLVIII—L ..	161

To be purchased at the Botanic Gardens, Singapore.
Price $3.00.

PRINTERS LTD., SINGAPORE.

THE
GARDENS' BULLETIN
STRAITS SETTLEMENTS

Vol VII 10th May, 1933 Part 2.

ADDITIONS TO THE FLORA OF THE MALAY PENINSULA.

By M. R. Henderson, F.L.S.

In the following paper forty-five species of flowering plants are recorded as additions to the flora of the Malay Peninsula, and a few nomenclatorial changes are made. Of these forty-five species, twenty-nine are described as new to science.

The recent more intensive exploration of the limestone areas of the Peninsula has yielded a number of interesting plants, sixteen additions being recorded from these areas, including four genera hitherto unknown in the Peninsula. Cameron's Highlands, an extremely interesting area from a botanical point of view, has also added three genera to the flora, as well as six new species. In all, no fewer than nine genera are here recorded which are additions to the flora. They are *Acanthopanax* (Araliaceae), *Ainsliaea* (Compositae), *Cipadessa* (Meliaceae), *Keenania* (Rubiaceae), *Myriophyllum* (Halorrhagaceae), *Pistacia* (Anacardiaceae), *Richeriella* (Euphorbiaceae), *Sumbaviopsis* (Euphorbiaceae), *Sycopsis* (Hamamelidaceae). It is interesting to note that of these the following are unknown from the Malay Islands, but that each has a representative in Luzon in the Philippines:—*Acanthopanax*, *Pistacia* and *Sycopsis*. The genus *Richeriella* has hitherto been known only from one species in the Philippines.

I am indebted to the Director of the Royal Botanic Gardens, Kew, and the staff of the Herbarium; to Mr. H. N. Ridley and Dr. E. D. Merrill for much kindly help; and to the Royal Botanic Gardens, Calcutta, the Botanic Gardens, Buitenzorg and the Bureau of Science, Manila for the loan of valuable material for comparison.

The drawings in this paper have all been made from herbarium specimens.

ANONACEÆ.

Goniothalamus tortilipetalum, sp. nov. **(Plate XV).**

A *G. giganteo,* Hook. fil. et Thoms. cui probabiliter affinis, foliis glabris latioribus, floribus minoribus, cauliforibus, viridis differt.

A slender stemmed *tree* c. 6 metres tall. *Branchlets* glabrous, bark pale grey to black, finely longitudinally wrinkled. *Leaves* up to 27 cm. long and 9.5 cm. broad, oblong to oblong ovate, sometimes slightly oblong obovate, pale brown olivaceous shining above when dry, dull pale brown below, glabrous, but both surfaces with minute pale brown or black glandular dots, base cuneate, apex with a short abrupt blunt acumen; *main nerves* up to about 20 pairs, interarching at about 6 mm. from the margin, with a series of subsidiary loops nearer the margin, tertiary nerves distinct, at least above, reticulations wide and distinct, those and the nerves raised and distinct on the upper surface, much less distinct below; midrib channelled above, strongly raised below. *Petioles* 1-1.3 cm. long, stout, black, finely wrinkled, deeply channelled above. *Flowers* 9 cm. long, entirely green, rising from small irregular woody tubercles on the main stem only, usually solitary but sometimes in pairs. *Pedicel* 3 cm. long, glabrous, brown when dry and finely wrinkled longitudinally, tapering from the apex downwards. *Sepals* 3 cm. long, 2.8 cm. broad, broadly triangular ovate, coriaceo-membranous, slightly cohering at base, base broad, apex with short blunt point, nerves and reticulations strongly marked, glabrous, shining on outer surface, dull on inner surface, the apex and margins near the apex minutely rufous glandular hairy, the rest of the inner surface except the basal portion with minute glandular dots. *Outer petals* 8.8 cm. long, 3.1 cm. broad, twisted, leathery, lanceolate, tapering to a narrowed blunt point, sometimes cohering at base to inner petals, both surfaces with scattered, very minute glandular hairs, nerves on outer surface raised and conspicuous when dry, on inner surface sunk and much less distinct. *Inner petals* 2 cm. long, oblong lanceolate, thick, fleshy, strongly cohering by the margins in their upper 2/3, the upper 1/3 coherent into a fleshy mass. *Stamens* numerous, incurved, 4 mm. long, longer than the ovaries, but exceeded by the styles, glabrous, the connective produced into a fleshy subulate point 0.6-0.7 mm. long. *Ovaries* linear oblong, flattened, 2-2.2 mm. long, tapering slightly to apex, adpressed silky golden hairy. Styles 4.5-5 mm. long, linear, flattened, tapering to a fine subulate point,

exuding a mucilaginous gum which in the dried flower causes them to adhere in a sticky mass. *Ovules* 1 or 2. *Fruit* unknown.

PAHANG: Tembeling, in lowland forest west of railway station, on calcareous soil, *Henderson 24543* (type); flr. May. Malay name: *kenerak.*

Xylopia tembelingensis, sp. nov. **(Plate XVI).**

X. Curtisii, King affinis, sed foliis minoribus subtus tomentosis, sepalis acuminatis, petalis longioribus differt.

A *tree* c. 25 metres tall. *Branchlets* whitish grey to black, longitudinally finely wrinkled with scattered lenticels, the young twigs with a sparse stiff black pubescence, the youngest parts with a dense reddish yellow mealy tomentum. *Leaves* very coriaceous, up to 24.5 cm. long and 7.8 cm. broad, oblong lanceolate-acute, margin somewhat undulate when dry, base narrowed, upper surface pale shining grey, glabrous, lower surface pale with a fine whitish close tomentum; *main nerves* 18 or 19 pairs, raised and bold below, connected by regular and almost straight cross veins; on upper surface nerves and reticulations distinct but very fine. *Petiole* up to 1.5 cm. long, stout, black, flattened or shallowly channelled above, sparsely pubescent or eventually nearly glabrous. *Flowers* yellow green, several together on stout, woody, tuberculate, sometimes branched extra-axillary peduncles c. 1 cm. long. Pedicels stout, 5-6 mm. long, reddish tomentose, bracteole broadly ovate to suborbicular, shortly acute, c. 7 mm. long and broad, reddish tomentose on both surfaces. *Sepals* spreading, 1 cm. long, fleshy, basal part broadly triangular ovate, 5-6 mm. wide just above base, rather abruptly narrowed into a triangular reflexed point, both surfaces tomentose except for the inner basal concave part. *Petals* subequal, somewhat fleshy, linear oblong or lorate with a tendency to be falcate, up to 6 cm. long but varying in length and width, the width varying from c. 2 mm. to 5 mm. or even more, narrowed usually to an obtuse point or sometimes almost truncate and mucronate, narrowed above the broadly ovate claw, and faintly keeled; the claw vaulted, glabrous within, tomentose without like both surfaces of the limb, and with a conspicuous keel. *Stamens* numerous, c. 65, 1.6-1.7 mm. long, filaments flattened below, connective obliquely truncate and depressed above, concealing the linear anthers. *Ovary* solitary, glabrous, cylindric, fluted, with very thick fleshy walls, together with stigma c. 3.2 mm. long, 1.2 mm. broad, multiovulate. *Stigma* pileate, fleshy, wrinkled. *Ripe carpels* oblong globose, up to 6.5 cm. long and 6 cm. broad, hard and woody, pale grey with numerous lenticels. *Seeds* c. 15-16, compressed, up to about 3 cm. long and 2 cm. broad.

PAHANG: Tembeling, in lowland forest to west of railway station, on calcareous soil, *Henderson 24533* (type); flr. and fruit May.

This species is evidently closely allied to *X. Curtisii*, King, having in common with it the stiff strongly nerved leaves, a similar flower with the pileate style, and hard globose woody carpels, but it differs in the tomentose lower surface of the smaller leaves, the differently shaped sepals and the much longer petals.

MELIACEÆ.

Dysoxylum undulatum, sp. nov. (Fig. 1).

D. ruguloso, King affinis, foliolis magis numerosis, floribus maioribus, fructu multo maiore differt.

A *tree* c. 12 metres tall. *Branchlets* stout, terete, longitudinally ridged, with prominent leaf scars, glabrous except for the youngest parts. *Leaves* up to c. 31 cm. long, equally pinnate, the petioles stout, minutely puberulous, swollen at base, flattened above; rachis angled, with fine raised lines running between the insertion of the petiolules. *Leaflets* usually 4 pairs, sometimes 5, subopposite or alternate, stiffly chartaceous or somewhat coriaceous when dry, lanceolate, ovate lanceolate or oblong lanceolate, acute, base cuneate, oblique or not, glabrous, up to 13 cm. long and 5 cm. broad; both surfaces minutely rugulose when dry and minutely black gland dotted; margins recurved and undulate; *main nerves* up to 9 pairs, raised and interrupted below, impressed and rather indistinct above; tertiary nerves and reticulations not visible except very faintly on very thin young leaves; *petiolules* stout, channelled above, 5 mm.—1 cm. long. *Racemes* spike like, stout, axillary or slightly supra-axillary, minutely pubescent, up to c. 8 cm. long. *Flowers* usually 3 or 4 together on very short stout bracteate peduncles, pedicels short, stout, jointed at the middle, densely minutely pubescent. *Calyx* shallowly and widely cupular, densely minutely pubescent, shortly 4-toothed, c. 1.8-2 mm. long and 5 mm. wide. *Petals* pale yellow green, oblong, apex triangular blunt, 8 mm. long, 3.2 mm. broad, reflexed in anthesis, tawny puberulous outside, much less densely so inside, apex and margins thickened. *Staminal tube* oblong, 4-angled, 7 mm. long and c. 3.2 mm. broad, constricted just below apex, margin slightly inflexed, rather irregularly 8-toothed, tawny puberulous on the angles, otherwise glabrescent outside and glabrous within. *Anthers* 8, very slightly exsert, narrowly oblong, c.

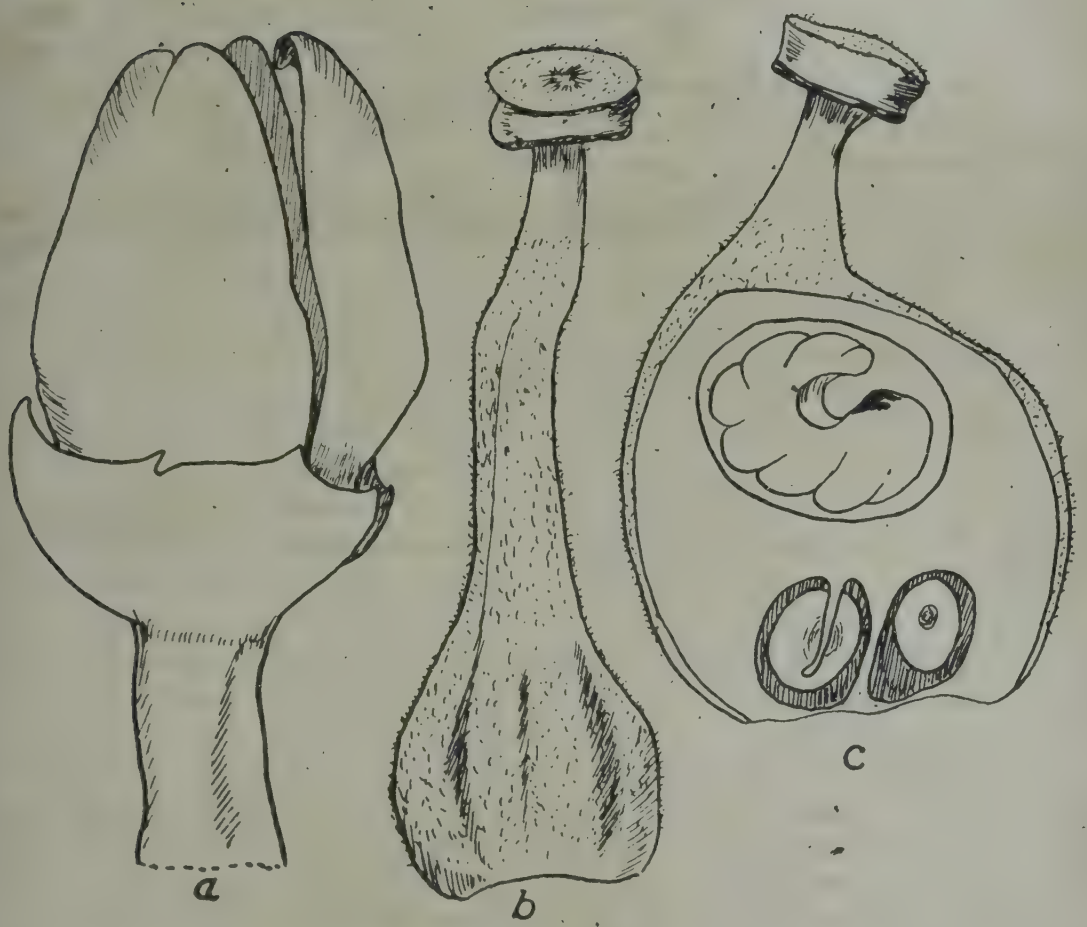


Fig. 1. Dysoxylum undulatum.

a. Bud, x c. 7.

b. Normal ovary and style, x c. 11.

c. Abnormal ovary and style, x c. 15.

1.1-1.2 mm. long. *Disc* shortly cylindric, slightly exceeding the ovary, c. 2 mm. long and broad, glabrous, fleshy, margin shortly erosulate dentate. *Ovary* 3-celled, ovoid or ovoid conic, vertically ridged, tawny pubescent, narrowed into the 4.5 mm. long style. Lower part of style 4-angled, pubescent, narrowing upwards, the upper 0.5 mm. glabrous. *Stigma* discoid with a basal annulus, top shallowly depressed or convex, pubescent. *Fruit* globose, ovoid, or depressed globular, very shortly apiculate, up to c. 5 cm. long and broad, narrowed at base into a short pseudostalk; pericarp woody, 5-6 mm. thick, glabrous, dark reddish brown when dry, yellow in life, finely rugulose, vertically ribbed. Fruiting peduncles stout, woody.

PAHANG: Cameron's Highlands, alt. c. 4600 ft., *Henderson 23484* (type of flower); *23624* (type of fruit); flr. and fruit April.

A specimen collected here in Nov. 1925 without flowers or fruit (*Henderson and Whitty 18007*) is almost undoubtedly this species although the leaflets are larger (up to 15 cm. long and 6.5 cm. broad). The Sakai name is given as *Sirai* (*Siral*), and the field note reads:—Inner bark saffron yellow, outer bark dark, apparently with large lenticels, 1/2-6/10 inch thick, sapwood distinct, yellow, 2-3 inches thick, heartwood reddish orange. Not common.

In a few flowers an abnormal ovary was observed which was ovoid conical or subglobose, much larger than the normal ovary and exceeding the disc, c. 2.8-2.9 mm. long and broad, narrowed abruptly into a style much shorter than that in normal flowers; loculi at base apparently with well developed ovules. These ovaries were found only in opened flowers, of which only a few were available for dissection. Many buds were dissected, but in all cases the ovary appeared normal. A vertical section of one abnormal ovary showed the presence of an insect larva in the upper half, as in fig. 1, c, so that it is possible that such abnormal ovaries are caused by insect attack.

Dysoxylum Corneri, sp. nov.

A speciebus aliis e peninsula malayana nervis magis numerosis, inflorescentia longissima spicatim recedit.

A *tree* 30-40 metres tall. *Branchlets* very stout, bark pale reddish brown and ribbed when dry, finely and closely yellow tomentose on youngest parts, otherwise glabrous. *Leaves* alternate, up to c. 75 cm. long, petiole stout, roughly triangular in section, rachis angled, the whole yellowish pubescent; *leaflets* 14-20, alternate or subopposite, chartaceo-coriaceous and brittle when dry, up to 19 cm. long and

6 cm. broad, oblong or occasionally lanceolate, caudate acuminate, base rounded or occasionally shortly cuneate, unequal; upper surface dull olivaceous brown or plumbeous, reddish brown in younger leaves, glabrous except for the yellowish pubescent midrib, minutely rugulose papillose with many minute black glandular dots; lower surface usually paler, glabrous except for the nerves and gland dotted like the upper surface; margins strongly recurved, almost revolute; midrib depressed above but with a raised central wing, very prominent below and more or less pubescent; *main nerves* up to about 25 pairs, slender and usually sunk above, elevate beneath, yellow pubescent or almost glabrous and then reddish, almost straight and parallel, curving rather abruptly up to the margin but not meeting; tertiary nerves short, usually almost invisible above and faint or invisible below; reticulations faint or invisible. *Petiolules* stout, channelled above, pubescent, c. 1 cm. long. *Inflorescence* an axillary apparently solitary spike exceeding 30 cm. in length, rachis stout, angled and striate when dry, closely and finely yellow tomentose, flowers in rather distant almost sessile cymules of 3 or 4. *Pedicel* very short and stout. *Calyx* shortly and widely campanulate or cup-shaped, c. 4.5 mm. long and 7 mm. wide, densely roughly pubescent, deeply wrinkled, margin obscurely 4-lobed and often incurved. *Corolla* in bud oblong, c. 9 mm. long. *Petals* 4 slightly imbricate in bud, at length reflexed, oblong blunt, densely reddish or yellowish tomentose outside, finely tomentose inside, somewhat fleshy, especially towards the apex, up to 10-12 mm. long and 3.5 mm. broad. *Staminal tube* c. 7 mm. long, 4-angled, cylindric oblong, somewhat constricted near the base, minutely pubescent outside especially on the angles, glabrous within; teeth 8, shortly and broadly triangular, blunt; *anthers* 8, included, oblong blunt, c. 1.2 mm. long. *Disc* cylindric annular, fleshy, c. 1.3 mm. tall, almost glabrous outside, densely pilose within with long shining pale yellow hairs, margin erosulate dentate. *Ovary* included within the disc, pyramidal, c. 1.2 mm. long and 1.5 mm. broad at base, densely pilose with long ascending shiny pale yellow hairs. *Style* 4-angled, hairy at the base like the ovary, glabrous above, 5 mm. long. *Stigma* cylindric capitate, with an annulus at the base, apex somewhat depressed and puberulous. *Fruits* 1-4 on stout peduncles up to 10 cm. long, pseudo-stalk very stout, 1-1.5 cm. long; depressed globose, 5-8 cm. long and 7-11 cm. broad, pumpkin-shaped, when dry deeply wrinkled and finely brownish mealy pubescent, in life bright gamboge yellow, probably turning orange or red when fully mature, loculi 4, marked

on outside over the septa by 4 deeply impressed lines radiating cruciately from the apex, 1-seeded, seeds 1-4 in each fruit, arillate.

SELANGOR: Weld Hill Forest Reserve, Kuala Lumpur, *Forest Dept. 2833* (type of flower), from tree No. 346, flr. March; same locality, *Forest Dept. sine num.*, from tree No. 345, flr. Feb.; same locality, *Forest Dept. 2433,* from tree No. 402, fruit July.

KEMAMAN: Bukit Kajang, Sungai Nipah, on hillside in forest, *Corner 25918* (type of fruit); fruit June.

The Malay names for this species vary considerably. The Weld Hill specimens are called respectively *Chengkuang, Gapis* and *Bekak. Corner 25918* is called *Keriah.*

The dimensions of the Weld Hill specimens are given as 70 feet high, girth 4 ft. 6 ins. The Kemaman specimen is much bigger, being 120 ft. tall, 60 ft. to the first branch, and 20 ins. in diameter 6ft. above the ground. The description of the fruit has been taken largely from Mr. Corner's copious field notes, further extracts from which are given below.

"Buttresses fairly prominent, 1 ft. wide, rising on an average to 5 ft. above the ground; bark light pinkish brown rather rough and flaky, fairly thick; sapwood white, heart wood dark reddish brown, trunk hollow in centre. Wood hard but easily split and rather brittle. Flesh of fruit very thick, pale yellow, with a watery sticky latex, the septa seen in transverse section as pale orange lines; seeds large with thick green cotyledons and fairly thick aril."

Cipadessa baccifera, Miq., Ann. Mus. Bot. Lugd. Bat. iv (1868-69) 6; Craib, Flor. Siam. Enum. i, 2(1926) 251.

KEDAH: Gunong Baling, *Best 20212.*

Aglaia tembelingensis, sp. nov. **(Plate XVII).**

Arbor parva. *Folia* ad 60 cm. longa. *Foliola* 11, imparipinnata, subopposita vel alterna, oblonga, ovato-oblonga vel obcuneata, ad 21 cm. longa et 8 cm. lata, supra glabra, subtus minute lepidota, nervis c. 18-jugis, supra impressis indistinctis, subtus elevatis stellato-tomentosis; *petioluli* ad 2 cm. longi. *Paniculae* ad 35 cm. longae, extra-axillares. *Calyx* 5-lobus, lobis inaequalibus, rufo-pubescentibus, ad 1.4 mm. longis et 1.2 mm. latis. *Petala* 5, 1.8-1.9 mm. longa et 1.1-1.2 mm. lata, ovato-oblonga vel obovata, glabra. *Tubus stamineus* breviter cylindricus, c. 0.6-0.7 mm. longus, glaber, antheris 5, margini adnatis, inclusis. *Ovarium* 2-loculare dense rufo-hirtum.

A small *tree. Branchlets* terete, densely covered with a minute brown scurf-like pubescence, with numerous paler

lenticels. *Leaves* up to c. 60 cm. long, unequally pinnate, petioles, rachis and petiolules scurfy pubescent. *Leaflets* usually 11, up to 21 cm. long and 8 cm. broad, the lower pairs alternate or occasionally subopposite, the upper pair opposite; lower leaflets oblong, oblong ovate or slightly obovate, apices abruptly acute, bases unequal, one side rounded, the other shorter and more or less cuneate; upper leaflets progressively more narrowed from about or above the middle, the terminal one obcuneate and much narrowed to the equal base; *petiolules* 1-2 cm. long; upper surface of leaflets dull grey or brown when dry, glabrous, lower surface dull reddish brown, very minutely scaly, the midrib and nerves with a shining brown red stellate pubescence; young leaves with a dense but quickly deciduous red stellate tomentum; *main nerves* about 18 pairs, prominent below, curving up into marginal loops, connected by fine but distinct, almost straight cross nerves; tertiary nerves very short; midrib and main nerves channelled on upper surface, rather faint, reticulations impressed, obscure. *Panicles* up to 35 cm. long, supra-axillary, usually rather lax, but occasionally strict, densely flowered, stellate red pubescent. *Pedicels* up to c. 2.5 mm. long, red pubescent, with a lanceolate acute bract c. 1.2 mm. long and 2 or 3 bracteoles. *Flower buds* ovoid, c. 2.2 mm. long and 2 mm. broad. *Calyx* 5-lobed, lobes unequal, somewhat concave, the largest broadly ovate, blunt, 1.4 mm. long and 1.2 mm. broad, externally densely red pubescent, internally glabrous, the smallest lobes of about the same length, but narrower and subacute. *Petals* 5, unequal, broadly ovate oblong or obovate, apex rounded, rather fleshy with thin margins, somewhat concave, glabrous, the largest c. 1.8-1.9 mm. long and 1.1-1.2 mm. broad. *Staminal tube* shortly cylindric, c. 0.6-0.7 mm. long, glabrous, rather fleshy, the mouth wavy. *Anthers* triangular, blunt, c. 0.3 mm. long, sessile on the margin of the staminal tube but inflexed so as to be included, at least in bud, into excavations on the inner face of the tube. *Ovary* 2-celled, broadly conical, depressed, not exceeding the staminal tube, densely red pubescent. *Stigma* glabrous, very short and broad, divided into 2 rounded lobes by a shallow depression. *Young fruit* broadly obpyriform or depressed globose, c. 2.5 mm. long and 3 mm. broad, densely shortly red pubescent, shallowly 4-lobed.

PAHANG: Tembeling, in lowland forest to west of railway station, on calcareous soil, *Henderson 24805* (type); flr. May.

This species does not seem to be closely allied to any of the Peninsular ones so far described, and would appear to approximate to *A. pauciflora*, Merr., a Philippine species.

SABIACEÆ.

Meliosma rufo-pilosa, sp. nov. **(Plate XVIII).**

Arbor c. 20 m., ramulis crassis. *Folia* imparipinnata, ad 55 cm. longa, foliolis 15 vel 17, lanceolatis, oblongo-lanceolatis vel ovatis, acuminatis, basi latis, plus minusve obliquis, ad 12 cm. longis et 4 cm. latis, nervis utrinque 8-13, subtus prominentibus, margine plerumque integro, plus minusve undulato, petiolis et petiolulis rufo-pilosis. *Paniculae* ad 55 cm. longae, multiflorae, inferne adpresse rufo-pilosae, ramulis et pedicellis ad 1.5 mm. longis fulvo-pubescentibus. *Sepala* 4, ovata vel ovato-lanceolata, inter se inaequalia, ad 2 mm. longa et 1-1.2 mm. lata, ciliolata. *Petala* exteriora glabra, late obovato-orbicularia ad 1.5-1.7 mm. longa et 2-2.8 mm. lata, interiora integra, oblongo-obovata c. 1 mm. longa, margine ciliolata. *Ovarium* glabrum.

A *tree* c. 20 metres tall. *Branchlets* very stout, terete, glabrous, pale brown to blackish brown, with numerous large conspicuous dark leaf scars. *Leaves* imparipinnate, crowded at branchlet ends, densely red pilose at insertion of petioles, up to c. 55 cm. long; *petiole* stout, expanded at base and flattened and slightly channelled above, black and finely longitudinally striate when dry under dense adpressed red hairs; rachis stout below, slender above, somewhat angled, grooved above, adpressed red hairy; *leaflets* 15-17, opposite or the lower ones alternate, 3.5-4.5 cm. apart, oblong, oblong-lanceolate to ovate, the lowermost pairs broader than the others, base broad and more or less oblique, the lower leaflets more oblique than the others, the upper ones often with cuneate and not oblique bases, lowermost leaflets c. 8.5 cm. long and 4 cm. broad, the upper ones from 6.5 cm. long and 2 cm. broad to 12 cm. long and 4 cm. broad, terminal leaflet lanceolate to oblong elliptic acuminate, base narrowed, equal, c. 7-8 cm. long and 3-3.5 cm. broad; upper surface when dry dull dark reddish brown glabrous except for a minute coarse pubescence on midrib and basal part of main nerves; lower surface reddish brown with long adpressed reddish brown deciduous hairs on midrib and main nerves; midrib sunk above, prominent below; *main nerves* c. 8-13 pairs, raised and fine above as are the reticulations, prominent below, almost straight or curving gently upwards and interlooping 3-5 mm. from the margin, with fainter subsidiary loops nearer the margin; cross nervules and reticulations raised and distinct; margin more or less undulate when dry, occasionally very obscurely toothed; *petiolules* 2-5 mm. long, adpressed red pilose below, channelled above and bordered by the decurrent margins of the blade. *Panicles* spreading, about as long as the leaves,

rachis stout, angled, adpressed red pilose towards base, red pubescent above, branches spreading, the lower primary ones up to c. 30 cm. long, the lower secondary ones of each branch up to 9-10 cm. long, bracts linear, densely red pilose, up to c. 3 mm. long. *Flowers* rather densely disposed on the densely fulvous pubescent ultimate branchlets, c. 2.5-3 mm. in diameter. *Pedicels* up to c. 1.5 mm. long, fulvous pubescent like the branchlets, bracteoles linear c. 0.3-0.5 mm. long, red pilose. *Calyx* lobes 4, ovate to ovate lanceolate, blunt or subacute, the largest c. 2 mm. long and 1-1.2 mm. broad, concave, the smallest c. 1.2-1.3 mm. long and 0.4-0.5 mm. broad, bases rather fleshy, margins thin and ciliate, glabrous within, the outer ones rufous pubescent at base without. *Petals* 5, the 3 outer broadly obovate orbicular, glabrous, one usually larger and much broader in proportion to length than the other two, c. 1.5 mm. long and 2.5-2.8 mm. broad, the other two c. 1.6-1.7 mm. long and 2 mm. broad; inner petals entire, attached to base of fertile stamens, oblong obovate blunt, c. 1 mm. long, margin at apex ciliate. Fertile *stamens* 2, c. 1.3-1.4 mm. long, filaments rather broad, flattened, apex expanded into a rather shallow bilobed cup; infertile stamens adnate to base of outer petals. *Disc* annular with 3 bifid processes with narrow blunt arms reaching about 2/3 up the ovary. *Ovary* glabrous, oblong or ovate oblong, apparently somewhat compressed, c. 0.6-0.7 mm. long, abruptly narrowed into a tapering glabrous style c. 0.7-0.8 mm. long. *Fruit* unknown.

PAHANG: Cameron's Highlands, c. 4600 ft., *Henderson 23657* (type); flr. pale green, in April.

Not closely related to any of the other Malay Peninsular species with pinnate leaves, and at once distinguished from them by the crowding of the leaves and panicles at the ends of the very stout branchlets in a manner that recalls some species of *Parishia* (Anacardiaceae).

ANACARDIACEÆ.

Pistacia malayana, sp. nov. **(Plate XIX).**

Arbor parva, ramulis glabris. *Folia* paripinnata vel imparipinnata, ad 11 cm. longa, rhachide anguste alata; foliola 7-8-juga, sessilia, alterna, subopposita vel opposita, glaberrima, oblongo-ovata vel oblongo-lanceolata, apice alte et late retusa, ad 3.5 cm. longa et 1.5 cm. lata, *nervis lateralibus* utrinque 7-9 supra prominentibus, subtus indistinctis, petiolo et rhachi sparse albo-pubescente vel fere glabro. *Paniculae* ♀ ad 7 cm. longae, sparse albo-pubescentes; pedicelli c. 0.5-0.7 mm. longi; *sepala* 4, c. 1 mm. longa et 0.5 mm.

lata, oblongo-ovata obtusa vel triangulari-ovata sub-acuta, ciliata; *ovarium* ovato-globosum, compressum, c. 0.6 mm. longum et latum; stylus brevis; stigmata 3, recurvata, dense et crasse pilosa. *Fructus* ovato-globosus, compressus, c. 4.5 mm. longus et 4.5 mm. latus.

A small much branched white barked *tree*. *Branchlets* stout, terete, glabrous, brownish or greyish brown, with raised lenticels. *Leaves* crowded towards branchlet ends, 9-11 cm. long, pinnate, usually without a terminal leaflet; petiole 1-2 cm. long, white pubescent, somewhat flattened above and very narrowly winged, slightly expanded at base; rachis sparsely white pubescent or nearly glabrous, narrowly winged, the wing broadest at the apex and there c. 0.5 mm. broad, narrowing downwards to the petiole; *leaflets* glabrous, 7-8 pairs, opposite, subopposite or alternate, sessile, or the lowermost one or two pairs very shortly petiolulate, up to c. 3.5 cm. long and 1.5 cm. wide, oblong lanceolate to oblong ovate, narrowed from about or a little below the middle to the base, apex rather deeply and widely retuse, almost emarginate, with a minute mucro at the base of the notch; texture thin in young leaflets, subcoriaceous in adult ones; upper surface reddish brown to black, shining when dry, lower dull and usually paler; margin recurved and somewhat undulate when dry; midrib raised and distinct on both surfaces; *main nerves* 7-9 pairs, spreading, fine but raised and distinct above, much less distinct below, reticulations practically invisible except by transmitted light. ♂ inflorescence unknown. ♀ *panicles* up to c. 7 cm. long from upper axils, sparsely white pubescent; flowers distant, subtended by persistent triangular ovate, concave blunt bracts coarsely ciliate on margin, c. 1-1.1 mm. long and 0.8-0.9 mm. broad; *pedicel* stout, c. 0.5-0.7 mm. long, with 2 bracteoles at apex oblong ovate concave, fleshy with thin coarsely ciliate margins, c. 0.7-0.8 mm. long; *perianth* lobes 4, c. 1 mm. long and 0.5 mm. broad, oblong ovate blunt or triangular ovate subacute, margins at apex with coarse reddish ciliate hairs, outer surfaces very minutely reddish scaly on median line; *ovary* ovoid globose, glabrous, strongly compressed laterally, oblique, pale coloured, c. 0.6 mm. long and broad; *style* short and stout, 3-partite almost to base, stigmas 3, large, recurved, almost revolute, flattened vertically, coarsely and densely reddish hairy on outer face, one much larger than the other two. *Fruit* ovoid globose, laterally compressed, somewhat oblique, c. 4 mm. long and 4.5 mm. broad, when dry pale brown and reticulate, when boiled finely longitudinally ridged, stigmas more or less persistent.

UPPER PERAK: Gunong Runto, Lenggong, c. 500 ft., on a dry rocky limestone ridge top, *Henderson 23831* (type); flr. and fruit June.

This species is closely allied to *P. weinnmanaefolia*, Pois. in Bull. Soc. Bot. France xxxiii (1886) 467, but is sufficiently distinct from it in the larger thinner leaflets more deeply and widely emarginate at the apex, in the pedicellate flowers and 4-not 5-lobed calyx.

The genus *Pistacia* has a distribution from the Canary Islands, the Mediterranean region, Abyssinia, Persia, Afghanistan, the Himalayas, Burma, Yunnan, North Central China and South China to Formosa and Luzon, with 2 species in Mexico and Texas. This is the first record of the genus from the Malaysian region.

CONNARACEÆ.

Connarus euphlebius, Merr. in Journ. Str. Br. Roy. As. Soc. 85 (1922) 200.

PAHANG: Pulau Tioman, *Henderson 21724*.

Described from British North Borneo.

LEGUMINOSÆ.

Abrus mollis, Hance in Journ. Bot. ix (1871) 130; Craib, Flor. Siam. Enum. i, 3(1928) 434.

PERLIS: Gua Nangka, *Henderson 23072*.

Desmodium lasiocarpum, DC., Prodromus ii, 328.

PERLIS: Gua Nangka, *Henderson 23075*.

Spatholobus compar, Craib in Kew Bulletin 1927, 62; Flor. Siam. Enum. i, 3(1928) 446.

PERLIS: Mata Ayer, near Kangar, *Henderson 23060*.

Vigna malayana, nom. nov. *Vigna parviflora*, Ridl. in Journ. Roy. As. Soc. Str. Br. 82 (1920), 181; Flor. Mal. Pen. i, 569, non Welw. ex Baker in Oliver Flor. Trop. Africa, ii (1871) 201.

Bauhinia decumbens, sp. nov.

Frutex scandens, cirrhosus. *Ramuli* juventute dense adpresse rufo-pubescentes, sulcati, demum glabri. *Folia* ad 6.5 cm. longa et lata, subrotunda, basi cordata, apice ad 1/3 bilobata, sinu triangulari, lobis acutis, supra matura glabra,

reticulatis tenuibus sed distinctis, subtus dense adpresse rubro-pubescentia, 11-nervia, nervis supra impressis, subtus prominentibus, petiolo ad 3.5 cm. longo. *Racemi* terminales vel axillares ad 9 cm. longi, adpresse rufo-pubescentes, pedunculo sulcato. *Bracteae* minutae, persistentiae. *Pedicelli* ad 2.5 cm. longi. *Calyx* in segmenta 2 vel 3 fissus, demum reflexa, extus rufo-pubescens, inter glaber. *Petalum posticum* subrotundum vel obovatum, stipite 1.5 mm. longo incluso 7-8 mm. longum, 6 mm. latum, extus rufo-pilosum, intus basi pilosum. *Petala lateralia* et antica subaequilonga ad 1.3 cm. longa et lata, stipitis rufo-pilosis ad 4 mm. longis, extus adpresse rufo-pilosa, intus glabra. *Stamina* fertilia 2 vel 3, filamentis c. 5.5 mm. longis, rufo-pilosis, ad apicem glabris, antheris glabris 2 mm. longis et latis. *Pistillum* dense rufo-pilosum c. 9 mm. longum, stipite c. 2 mm. longo, *stylo* c. 5 mm. longo, ovulis 4 vel 2.

A low *scrambling shrub* with tendrils. Young shoots, stems and tendrils densely adpressed red pubescent, young stems grooved when dry; older parts of stem and tendrils brownish black when dry, with a sparse pale pubescence, eventually becoming glabrous and lenticellate. *Leaves* subrotund, 6.5 cm. long and broad, deeply and narrowly cordate at base, apex deeply bilobed, the sinus rather wide, triangular, the lobes triangular acute up to about 2.5 cm. long; texture coriaceous, upper surface with a fine but distinct raised reticulation, glabrous except for a fine brown pubescence on the main nerves in the younger leaves, the lower surface densely covered with adpressed, shining, deep coppery-red hairs, persistent but becoming paler in older leaves, edge of leaf somewhat thickened and white hairy. *Stipules* deciduous. Insertion of petiole glandular, emitting 11 nerves sunk above, prominent below and covered with the same pubescence as the under surface of the leaf; transverse nerves inconspicuous above, not prominent below except in older leaves. *Petiole* up to about 3.5 cm. long, clothed with the same pubescence as the young stems. *Racemes* terminal or axillary, c. 9 cm. long, all parts adpressed red pubescent, peduncle sharply 4-angled and grooved. *Bracts* very small, persistent. *Pedicels* up to 2.5 cm. long. Buds globose with a very short point. *Calyx tube* 1.3 cm. long, ribbed, narrowed into but distinct from pedicel, which has 2 minute bracteoles, one 2 mm. below the other, the uppermost 4 mm. below the apex of pedicel. *Calyx* splitting into 2 or 3, usually 2 oblong ovate blunt lobes c. 5 mm. long, adpressed red pubescent outside, glabrous within, reflexed after expansion of flower. *Upper petal* subrotund or broadly ovate, lamina 6 mm. long and broad, outer surface with long adpressed coppery-red shining hairs, the

inner glabrous except on the nerves, narrowed into a red-pilose claw c. 1.5 mm. long. *Lateral* and *lower petals* subequal, much larger than upper petal, lamina rotund, up to c. 1.3 cm. long and broad, the tip sometimes retuse, outer surface adpressed pilose as in upper petal, inner surface glabrous, bullate, the sunk veins conspicuous in life, less so in dried specimens, claw red pilose c. 4 mm. long. *Stamens* 3, subequal, one sometimes reduced, filaments broad at base, densely red pilose, tapering at apex and there glabrous, c. 5.5 mm. long, anthers glabrous, 2 mm. long and broad. *Pistil* 9 mm. long, stalk c. 2 mm. long, densely covered with shining red hairs, *style* c. 5 mm. long; *ovules* 2 or 4. *Fruit* unknown.

PAHANG: Gunong Senyum, on open top of limestone hill, scrambling over rocks, *Henderson 22268* (type); flr. July.

Evidently allied to *B.cuprea*, Ridl., to which it was at first referred, but distinct from that species in its smaller, stiffer, more deeply cordate leaves with more nerves, and in the more rounded flower buds and the smaller, more hairy flowers.

The shining deep coppery-red indumentum on the backs of the leaves and petals is very striking.

ROSACEÆ.

Pygeum odoratum, sp. nov. **(Plate XX).**

Affinis *P. Scortechinii*, King, sed foliis glandulosis, pro rata latioribus, subtus minus rugulosis, nervulis magis prominentibus, racemis longioribus, staminibus magis numerosis differt.

A rather stout bushy *tree* c. 12-14 metres tall. *Branchlets* terete, black, striate, lenticellate, obscurely adpressed reddish yellow pubescent, at length glabrous. *Leaves* thinly coriaceous, up to 8 cm. long and 4.25 cm. broad, elliptic lanceolate to elliptic ovate, apex acute or shortly obtusely acuminate, base cuneate with 2 glands usually between the first and second pair of nerves; upper surface glabrous, more or less shining dark reddish brown, lower surface slightly rugulose, dull brown, glabrous except for a few minute and very obscure adpressed bristles on the recurved margins, youngest leaves adpressed bristly hairy below and on the midrib above; midrib channelled above, prominent below; *main nerves* 7-9 pairs, impressed and rather indistinct above, slender but distinct and raised below, curving up to and along the margin and anastomosing;

cross nervules and reticulations almost invisible above, lax below, raised and rather faint. *Petiole* up to 1 cm. long, channelled above, sparsely pubescent especially near the base, or almost glabrous. *Racemes* solitary axillary, 4-5 cm. long, covered with coarse adpressed reddish yellow bristly hairs, as are the pedicels and calyces. *Pedicels* 3-4 mm. long. *Calyx tube* narrowly campanulate or somewhat obconic, c. 2 mm. long, lobes 6, linear oblong, c. 1.8 mm. long, very hairy. *Petals* 6, similar to calyx lobes but smaller and caducous. Stamens about 24-26, in 2 series, filaments glabrous, exserted, up to 4 mm. long. *Ovary* ovoid, c. 1 mm. long, sparsely hairy with long shining pale yellow hairs, *style* c. 4.2 mm. long, glabrous or with a few shining yellow hairs. *Stigma* capitate. *Fruit* unknown.

PAHANG: Cameron's Highlands, alt. c. 4800 ft., *Henderson 23278* (type) ; flr. April. A very floriferous tree, the flowers white with a pink tinted calyx, strongly rose scented.

Parinarium latifolium, sp. nov.

Ab speciebus aliis e peninsula malayana foliis latioribus, inflorescentiis brevioribus, floribus maioribus recedit; affinis *P. glaberrimo,* Hassk., sed ramulis foliisque haud glabris, foliis latioribus differt.

A small *tree* c. 5 metres tall. *Branchlets* terete, covered with a long woolly yellowish tomentum. *Leaves* thinly coriaceous, 18-21 cm. long, 10-11.5 cm. broad, broadly elliptic, apex shortly and abruptly caudate acuminate, base shortly rounded, upper surface glabrous, lower surface sparsely strigose on midrib, main nerves and reticulations; midrib raised above, prominent below, main nerves and reticulations impressed and distinct above; *main nerves* c. 14 pairs, strongly raised below, curving up to the margin and anastomosing, tertiary nerves and cross nervules very distinct, reticulations fine but distinct. *Petioles* stout, 5-7 mm. long, yellow woolly. *Inflorescence* spike like, up to 5 cm. long but possibly elongating further, densely tawny silky, bracts numerous, oblong ovate to ovate lanceolate, acute, adpressed tawny hairy outside, adpressed yellowish pubescent inside, up to 1.5 cm. long. *Calyx* tube narrow oblong cylindric, 7-8 mm. long, adpressed pubescent, lobes broadly lanceolate or oblong ovate, acute, 10 mm. long, outside densely adpressed -long hairy, inside densely shortly pubescent. *Petals* thin, glabrous, obovate, narrowed to rounded base, 10-11 mm. long, 7-8 mm. broad. *Stamens*

c. 20, united below into a ring c. 2 mm. tall and red pubescent within, filaments slender, tapering upwards, 10-12 mm. long. *Ovary* densely red pilose, style slender, as long as the stamens. *Fruit* unknown.

KEDAH-PERAK boundary: Bukit Kuala Ketang, nr. Gunong Bintang, *Haniff 21119* (type).

HAMAMELIDACEÆ.

Sycopsis sp.

PAHANG: Cameron's Highlands, alt. c. 4600 ft., *Henderson 23567, 23316*. A slender tree c. 50 ft. tall. Unfortunately only fruiting specimens have been collected, and the generic status of the plant is therefore doubtful. It somewhat resembles *Sycopsis tutcheri*, Hemsl. from China, but is distinct from that and other described species.

What appears to be another species of the same genus was collected, also in fruit, in the same locality under the Sakai name of *Senglong* (*Henderson and Whitty 18084*).

So far the genus *Sycopsis* has been recorded only from the Himalayas, China and the Philippines.

HALORRHAGACEÆ.

Myriophyllum sp.

JOHORE: Bukit Tiga, Sungai Sedili, *Corner sine num.* "Common by edge of river from Kuala Bohol to a short way below Bukit Tiga. Does not grow in the salt water of the mangrove reaches." Malay name: *Rumput Ekor Kuching.*

Unfortunately only the submersed stems and leaves, without flowers or fruit have so far been found, so that it is impossible to say to what species it may belong.

This is the first definite record of the family from the Malay Peninsula.

MELASTOMACEÆ.

Medinilla crassiramea, sp. nov. **(Plate XXI).**

Ab *M. perakense*, King ramulis multo crassioribus, magis tuberculatis, nervis subtus pubescentibus, inflorescentiis maioribus, pubescentibus, differt.

A large *epiphytic shrub*. *Branchlets* very stout and woody, 1-1.5 cm. in diameter, bark rough and longitudinally cracked, pale under a dense rufous furfuraceous tomentum and with numerous large rounded tubercles. Nodes thickened, 5-6 cm. apart, bearing whorls of 5 leaves. *Leaves* stiffly coriaceous when dry, up to 15 cm. long and 9 cm. broad, ovate, oblong ovate or elliptic rotund, apex blunt, rounded or minutely retuse, base cordate, pale when dry, glabrous above, below with very sparse minute reddish hairs, midrib very prominent below; *main nerves* 3 pairs, 2 pairs basal the third from higher up the midrib, the lower most pair of the basal nerves very faint, running parallel to and close to the margin, the second pair much more prominent, also running parallel to the margin, but becoming faint near the apex, the third pair bold, curving inwards at apex to meet the midrib; midrib and main nerves densely adpressed red hairy below, glabrous and much less distinct above, the straight cross nervules just visible on both surfaces as faint impressed lines. Petioles stout, up to 5 cm. long, red adpressed hairy when young, glabrescent when older and longitudinally striate. *Cymes* umbelliform, from axils of lower or fallen leaves, up to 7 cm. long and wide, the common peduncle 4-5 cm. long, bearing at its apex about 10 branches c. 2 cm. long which are usually again umbellately branched, each branchlet with a few flowers, the whole inflorescence rusty furfuraceous. *Pedicel* short. *Calyx* obconic, somewhat angled, 3-4 mm. long, 3.5 mm. wide, sparsely red hairy, teeth 5, minute, subulate, acute. *Petals* 5, white, up to 5.5 mm. long and 5 mm. wide, oblong ovate, obovate or obovate rotund, 2 usually larger and broader than the other 3, apex rounded, truncate or minutely apiculate. *Stamens* 10, equal, filaments 3 mm. long, anthers inflexed in bud, 2-2.5 mm. long, with 2 very small blunt tubercles at the base in front and a very short blunt spur behind. *Style* 4.5 mm. long. *Fruit* (? unripe) more or less globular, sparsely rusty pubescent, crowned by calyx, c. 5.5 mm. in diameter.

PAHANG: Gunong Batu Brinchang, Cameron's Highlands, alt. c. 6600 ft., epiphytic on ridge-top trees, *Henderson 23588* (type); flr. and fruit April.

Remarkable on account of the very thick and rough branches.

Marumia dimorpha, Craib in Kew Bull. 1930, 320; Enum. Siam. Pl. i, 4, 696.

PAHANG: Tasek Bera, *Henderson 24057*.

Described from Lower Siam.

Sonerila Whittyi, Hend. in Journ. Mal. Br. Roy. As. Soc. v, 2 (1927) 249. Further collections of this plant

from the type locality show it to be synonymous with **Sonerila capitata**, Stapf & King, Mat. Flor. Mal. Pen. No. 11 (1900) 35; Ridl., Flor. Mal. Pen. i, 787.

ARALIACEÆ.

Schefflera musangensis, sp. nov. **(Plate XXII).**

S. venulosa, Harms. affinis, sed foliolis latioribus, nervis lateralibus haud obliquis, nervis nervulisque supra minus, subtus magis conspicuis, floribus maioribus differt.

An epiphytic climbing *shrub*. *Leaves* digitate, leaflets coriaceous, 3-6, 7-20 cm. long, 3-9 cm. wide, variable in shape from elliptic lanceolate to ovate or obovate, base rounded or abruptly shortly cuneate, often oblique, apex acute, margin usually somewhat thickened with distant shallow crenatures or almost entire, glabrous, upper surface shining pale yellowish or greenish brown when dry, lower surface dull pale brown; *main nerves* up to about 13 pairs, spreading, (the basal pair oblique) prominent and somewhat irregular below, some leaves having only half the normal number, curving up at the margin and anastomosing, reticulations lax and conspicuous; nerves and reticulations usually indistinct above; *petiole* up to 26 cm. long, stout, glabrous, finely longitudinally ridged when dry, petiolules 1-6 cm. long, glabrous and ridged like the petioles. *Panicles* terminal, up to 12 cm. long and about 18 cm. across, with up to about 8 glabrous, flattened and finely longitudinally ridged branches, peduncles spreading, c. 2 cm. long, bearing dense umbels of 15-20 flowers. *Pedicels* c. 3 mm. long. *Calyx* obconic, c. 1.5 mm. long, and 3 mm. wide across the mouth, margin minutely toothed. *Petals* 5 or 6, triangular ovate acute, 3.2 mm. long, 2 mm. broad, apex thickened, reflexed in anthesis. *Disc* short fleshy, wrinkled. *Stamens* as many as petals, filaments slender, 4.5 mm. long, somewhat dilate at base. *Anthers* deltoid, blunt, dorsifixed, cells finely reticulate and free from one another for a short distance at apex and base. *Fruit* oblong, broadly oblong, or elliptic, sharply 6 or 7 ridged, c. 6-7 mm. long.

KELANTAN: Sungai Galas at Gua Musang, climbing on riverside trees of *Dipterocarpus oblongifolius*, Bl., *Henderson 22599* (type); flr. and fruit Aug.

Acanthopanax malayana, sp. nov. **(Plate XXIII).**

Arbor glaber (ad c. 16 m.), rami glabri, sulcati, inermes. *Petioli* ad 12.5 cm. longi. *Foliola* 3-5 digitatim, lanceolata, ad 16 cm. longa et 5.5 cm. lata, glabra, margine

spinulosa. *Pedunculi* ad 9.5 cm. longi, glabri, sulcati. *Pedicelli* ad 2 cm. longi, graciles, glabri. *Calycis* tubus campanulatus, breviter 4-dentatus. *Petala* 4, ovato-oblonga, mucronata, reflexa, 2.5 mm. longa et 1.5 mm. lata. *Stamina* 4, filamentis c. 2.7 mm. longis. *Styli* 2 in unum concreti vel ad medium bifidi. *Fructus* ignotus.

A slender unarmed *tree* up to about 16 metres tall, bark rather smooth and papery, wood soft and white. *Branchlets* pale, glabrous, longitudinally ridged when dry. *Leaves* digitate, clustered at branch ends, 3-5 foliolate, glabrous; *leaflets* lanceolate acute, narrowed to base, up to 16 cm. long and 5.5 cm. broad, margin with rather long spinulose teeth; *main nerves* up to 10 pairs, prominent below and interarching, less prominent above; both surfaces with a close raised reticulation, more prominent above than below. *Petioles* up to 12.5 cm. long, glabrous, longitudinally ridged when dry. *Petiolules* 1 cm. long or shorter. *Flowers* umbelled, peduncles up to 9.5 cm. long, glabrous and ridged like the petioles; about 40 to 50 flowers to an umbel, pedicels slender, glabrous, up to 2 cm. long. *Calyx* campanulate, c. 1.2-1.4 mm. long, teeth 4, small, broadly triangular ovate acute. *Petals* 4, ovate oblong mucronate, green tinged red, reflexed, somewhat leathery in texture, slightly glandular pubescent at apex, 2.5 mm. long and 1.5 mm. broad, distinctly keeled within. *Stamens* 4, filaments linear flattened, tapering upwards, c. 2.7 mm. long; *anther cells* dorsifixed, sub-reniform, introrse, c. 1.5 mm. long. *Styles* 2, connate at first for their whole length, but becoming free to about half way in older flowers. *Disc* conspicuous in life, yellow green. *Fruit* unknown.

PAHANG: Cameron's Highlands, beyond Tanah Rata, alt. c. 4600 ft., *Henderson 23476* (type); flr. April; near Brinchang camp, on ridge-tops, alt. c. 5200 ft., *Henderson and Whitty 18016, 18042* (sterile specimens). Sakai name: *Berlaki.*

This tree was not uncommon near the path between Tanah Rata and Brinchang camp, occurring in groups of a few individuals, and conspicuous when flowering by reason of its rather delicate feathery foliage which was pale green with a reddish tinge, the petioles and inflorescence also being reddish tinged.

This is the first record of the genus *Acanthopanax* from the Malay Peninsula. It extends from India to China and Japan, and one species has been recorded from the northern part of Siam and from the Philippines. It does not appear to be recorded from Sumatra, Java or Borneo, and this would seem to be its furthest known extension southwards.

CORNACEÆ.

Alangium Kurzii, Craib in Kew Bulletin 1911, 60; Flor. Siam. Enum. i, 4(1931) 806.

PAHANG:- Pulau Tioman, *Henderson 21750.*

RUBIACEÆ.

Keenania modesta, Hook. fil., F.B.I. iii, 101.

PAHANG: Sungai Tahan, *Ridley;* Sungai Tekai, in flood damaged jungle on riverbank, *Henderson 24846.*

NEGRI SEMBILAN: Gunong Tampin, *Burkill 3169.*

These specimens agree well with the original collection from India. I have not seen *Keenania capitata*, Craib, Enum. Siam. Pl. ii, 82 (*Myrioneuron capitatum*, Ridl.), but this apparently differs from our plant in the longer peduncle. *Keenania modesta* has hitherto been known only from the type collection from Cachar.

Lasianthus scalariformis, King and Gamble, Mat. Flor. Mal. Pen. No. 15, 131. **(Plate XXIV).**

This species was described from scanty material collected on Gunong Batu Puteh, Perak at an altitude of 6700 ft., *Wray 332;* and in Perak without locality or number by *Scortechini.* It was collected again in Pahang, on Gunong Tahan, alt. c. 6000 ft., *Holttum 20722;* and on Gunong Batu Brinchang, Cameron's Highlands, alt. c. 6500 ft., *Henderson 23593.*

The following is a description of the inflorescence:— *Peduncles* solitary, ebracteate, stout, up to c. 1 cm. long, glabrous or stiffly sparsely black hairy, finely longitudinally striate when dry, with 2 branches 2-4 mm. long subtended by very small narrow acute bracts and each bearing usually 3 flowers. *Flowers* sessile, c. 6 mm. long. *Calyx* tube obconic or campanulate, c. 2 mm. long and 1.5 mm. broad at apex, lobes 5, c. 4 mm. long and 1.5 mm. broad, oblong ovate or oblong lanceolate ovate, acute or somewhat rounded at tip, base broad, rather fleshy, margin sparsely adpressed setose pilose, outer surface glabrous, inner sparsely adpressed pilose near base or nearly glabrous, when dry strongly keeled on the median line within and deeply channelled without. *Corolla* pale lilac, early deciduous, cylindric oblong, c. 5 mm. long and 2 mm. broad, sparsely puberulous without; lobes 5, reflexed, triangular or narrowly triangular ovate acute, glabrous within except at apex, puberulous without, c. 2-2.5 mm. long, apex thickened; throat of corolla

densely pilose with long pale hairs. *Anthers* narrow oblong, c. 1.2 mm. long, filaments very short. *Style* c. 5.5 mm. long, slender, glabrous, tapering upwards, stigma of 2 broadly obtriangular retuse lobes. *Disc* annular, c. 0.5 mm. tall and 1.2 mm. across, with 5 very thick and fleshy blunt rounded lobes. *Fruit* globose, narrowed to base, c. 4 mm. long and 3.5 mm. broad, crowned by the persistent calyx lobes, when dry with 5 conspicuous broad flattened ridges.

Wendlandia ternifolia, Cowan in Notes Roy. Bot. Gard. Edinb., Vol. XVI, No. lxxx (1932) 279.

JOHORE: Pulau Pelandok at sealevel, *Holttum 24960;* flr. July.

Described from Indo-China.

Attention may be called here to Dr. J. M. Cowan's recent monograph on the genus *Wendlandia* in the publication cited above. He erects two new species, *W. arborescens* and *W. Burkillii,* for the Malay Peninsular plants which up to the present have been considered to belong to *W. paniculata,* DC.

COMPOSITÆ.

Ainsliæa reflexa, Merr. in Philipp. Journ. Sci., i (1906) Suppl. 242; Enum. Philipp. Pl. iii, 620.

PAHANG: Cameron's Highlands, c. 5000 ft., *Holttum 24991.*

This is the first record of the genus from the Malay Peninsula. *A. reflexa* is known from the Philippines and Formosa, and the rest of the genus is mostly Chinese and Japanese, with species in the Himalayas and Burma and one in Sumatra.

LOBELIACEÆ.

Pratia montana, Hassk., Cat. Hort. Bog. Alt. 106.

PAHANG: Cameron's Highlands, c. 4800 ft., *Henderson 23296;* flr. April.

Distrib: Sumatra and Java.

APOCYNACEÆ.

Urceola montana, sp. nov. **(Plate XXV).**

A *U. torulosa,* Hook. fil. inflorescentia multo maiore et laxiore, sepalis minoribus, acutis, lobis corollæ intus pilosis, folliculis multo brevioribus, vix torulosis recedit.

A *liane* climbing on tall trees. *Branchlets* black when dry, finely striate and with numerous pale lenticels, youngest

twigs brown. *Leaves* opposite, up to 12 cm. long and 5 cm. broad, much smaller on branchlet ends, glabrous, thinly coriaceous, lanceolate, oblong lanceolate to elliptic, apex shortly and obtusely caudate, acuminate, base narrowed, upper surface shining reddish brown when dry, lower dull and paler; midrib impressed above, elevated below; *main nerves* up to about 8 pairs, rather faint and usually impressed above, conspicuous and raised below, curving along and anastomosing indistinctly close to the recurved margin, transverse nervules and reticulations not conspicuous except in young leaves. *Petiole* glabrous, c. 1.5 cm. long, channelled. *Inflorescence* axillary and terminal of trichotomous panicles of cymes, up to 10 cm. long and broad, minutely sparsely pubescent, primary peduncles up to about 4.5 cm. long, secondary 1-1.3 cm. long, tertiary 7-8 mm. long, bracts linear lanceolate c. 3 mm. long; cymules lax, of about 4 flowers, pedicels c. 4 mm. long, bracteoles very small. *Calyx* lobes 5, somewhat spreading, broadly triangular ovate acute, edges minutely pubescent, c. 0.6-1 mm. long, 0.5-0.8 mm. broad. *Corolla* 5-lobed, urceolate or subglobose, c. 2 mm. long. *Petals* easily separable from one another, up to about 2.2 mm. long and 1 mm. broad, ovate lanceolate, blunt or subacute, fleshy, glabrous outside except for a minute pubescence at the apex, within with long shining adpressed white hairs and a glandular thickening on the margins just above the tips of the stamens. *Stamens* sagittate, 1.3 mm. long, filaments short, broad, flattened, c. 0.5 mm. long; anthers c. 1 mm. long, apex thin, rounded; spurs straight. *Disc* conspicuous, fleshy, cylindric annular, c. 0.4 mm. tall, edge wavy. *Ovary* of 2 carpels not exceeding the disc, but surrounded by a dense ring of long hairs protruding beyond the disc. *Style* and stigma c. 1 mm. long, style short, broad, obconic. *Stigma* narrowly conic acute, ridged. *Follicles* up to 9 cm. long and about 1-1.5 cm. thick, diverging only slightly, tapered to apex and base, with a few broad, shallow constrictions, scarcely torulose. *Seeds* unknown.

PAHANG: Cameron's Highlands, 4600-4800 ft., *Henderson 23601* (type), *23472*, *23486;* flr. and fruit April. Flowers white or greenish white, fragrant. Follicles brown.

Apparently intermediate between those species with terete or dagger shaped follicles and those with definitely torulose and very much elongated follicles.

ASCLEPIADACEÆ.

Toxocarpus glabrescens, sp. nov. **(Plate XXVI).**

T. Curtisii, King et Gamble affinis, foliis pro rata angustioribus, glabris, vix obovatis, inflorescentiis et sepalis fere glabris differt.

A slender *climbing shrub*. *Branchlets* glabrous, pale brown, angled and ridged, youngest parts sparsely red hairy. Leaves elliptic lanceolate, elliptic, or slightly elliptic obovate, up to 9.5 cm. long and 4.5 cm. wide, glabrous, coriaceous, apex cuspidate acuminate, base cuneate, upper surface when dry shining reddish or olivaceous brown, lower paler and duller; midrib impressed above, bold below with sparse adpressed red hairs; *main nerves* 5-6 pairs, distant, faint above, distinct below, starting at an angle of about 70° to the midrib, at first straight then curving up to form somewhat indistinct loops a little distance from the recurved margin; reticulations rather indistinct. *Petioles* up to 1 cm. long, adpressed red hairy when young, becoming glabrous when older. *Cymes* 3-4 cm. long, sparsely red hairy or almost glabrous, sessile or shortly pedunculate, branches 2-4, divaricate, flowers racemosely clustered on the branchlets; bracts small, ovate blunt, edge and back rufous hairy; *pedicel* less than 1 mm. long, bracteoles similar to bracts but smaller. *Calyx* tube short, lobes 1.8-2 mm. long, 1.2-1.4 mm. broad, ovate blunt, slightly concave, thickened in centre, edges thin, a few red hairs on the outside and on the margin at the apex. *Corolla* c. 6 mm. long in bud, tube 2-2.5 mm. long, inflated at base, lobes c. 4 mm. long, linear oblong, blunt, twisted, somewhat thicker in texture than the tube. *Corona* processes adherent to anthers and much longer than them, the bases broad and horizontally 2-toothed, the tips produced into long points at first bent inwards at right angles towards the style apex, then again at right angles vertically; connective with a minute broad appendage bent inwards. *Style* apex annular and lobed at base with a subulate process 3.5-4 mm. long which is flattened and flexuous and sometimes twisted in the upper one-third. *Fruit* unknown.

JOHORE: Tanah Abang, Endau river, alt. c. 700 ft., *Holttum 24937* (type); flr. July. "Climber on hilltop. Flower buds purple, petals yellow suffused purple towards edges."

Toxocarpus pauciflorus, sp. nov. **(Plate XXVII).**

Inter species peninsulae malayanae foliis minoribus, inflorescentiis laxioribus, floribus paucioribus distincta.

A slender climbing shrub. *Branchlets* brown when dry, ridged, glabrous or sparsely reddish hairy. *Leaves* chartaceo-coriaceous, up to 5.5 cm. long and 3.5 cm. broad, elliptic lanceolate, elliptic or ovate, apex shortly and broadly caudate acuminate, base narrowed and rounded, rarely cuneate, upper surface glabrous, reddish or greenish brown, lower surface pale, with very sparse reddish hairs; midrib impressed above, raised below; *main nerves* 3 or 4 pairs,

distant, impressed and rather faint above, raised below, leaving the midrib at an angle of about 50° and curving up to form loops some distance from the margin; tertiary nerves and reticulations lax, impressed and indistinct above, raised and more or less distinct below. *Petioles* 5-8 mm. long, sparsely red pubescent or nearly glabrous. *Cymes* up to 2.5 cm. long, lax, sessile, usually with two divaricating slender branches, very sparsely red hairy or almost glabrous, cymules of 2 or 3 flowers. *Pedicel* slender 5-6 mm. long. *Calyx* tube very short, scales very minute, alternate with the lobes, lobes ovate lanceolate blunt, c. 2 mm. long and 1 mm. broad, margin towards apex shortly ciliate, outside with a few long adpressed red hairs or nearly glabrous. *Corolla* tube urceolate or subglobose c. 2 mm. long, glabrous without, pubescent within, lobes linear oblong acute, twisted, c. 6.5 mm. long, glabrous except at base within. *Coronal* processes laterally flattened, back expanded, with 2 horizontal blunt lobes at base, apex 2-toothed, the outer tooth narrow triangular acute, slightly incurved, the inner subulate, slightly longer and incurved to the style apex; connective very broad, very shortly and minutely appendaged. *Style* 0.5-0.6 mm. long, apex annular with a columnar process 1.5 mm. long bifid at apex. *Fruit* unknown.

PAHANG: Bukit Chintamani, between Bentong and Karak, on the edge of a clearing at base of limestone cliff, *Henderson 25034* (type); flr. dull pink, in October.

Tylophora Ridleyi, nom. nov.

Gymnema flava, Ridl. in Journ. Str. Br. Roy. As. Soc. lvii (1911) 68; Flor. Mal. Pen. ii, 385.

The presence of coronal scales attached to the staminal column and the included style apex would place this plant in *Tylophora* rather than *Gymnema*.

Tylophora calcicola, sp. nov. (Fig. 2).

T. Ridleyi Hend. affinis, sed foliis multo maioribus, semper cordatis, petiolis longioribus, pedicellis longioribus, floribus albis haud flavis differt.

A slender *twiner*, older stems glabrous, angled and ridged, younger parts terete, sparsely pubescent. *Leaves* membranous when dry, somewhat coriaceous when old, up to 8.5 cm. long and 5 cm. broad, ovate or oblong ovate acuminate, base cordate, margin minutely ciliate pubescent, otherwise glabrous; midrib slender, raised on both surfaces, minutely and sparsely puberulous above; *main nerves* 4-6 pairs, slender, raised on both surfaces, the lowest three pairs from the base, the others distant, all curving up towards the margin and interlooping; cross nervules lax, indistinct, reticulations fine, obscure. *Petioles* slender, 1.5-3

Fig. 2. Tylophora calcicola.

a. Expanded flower, x c. 10.

b. Flower bud, x c. 10.

c. Flower with petals removed and calyx flattened, showing staminal column, x c. 40.

cm. long, glabrous or sparsely pubescent. *Cymes* axillary, up to 3 cm. long, main peduncles slender, pubescent, up to 2.5 cm. long, usually with one or two short pubescent branches bearing rather dense umbellate clusters of up to about 10 flowers. *Pedicels* slender, pubescent, up to 6 mm. long. *Calyx* pubescent outside, lobes ovate lanceolate to ovate, subacute or blunt, up to 1 mm. long and 0.7 mm. broad, edges ciliate, glands minute. *Corolla* tube more or less oblong or obconic, c. 1 mm. long; buds oblong truncate with the upper parts of the lobes inflexed and bent downwards; in the opened flower the lobes 2.5-3 mm. long, rather fleshy, the basal part oblong, then suddenly contracted into a narrow oblong thickened tail caused by the margins becoming strongly recurved, the lower margins also becoming recurved in the older flowers, puberulous within. *Corona* processes shorter than staminal column, ovate globose, fleshy, somewhat concave and closely adpressed to the backs of the anthers; *anthers* broad with a short broad rounded appendage slightly exceeding the style apex; pollinia very small, narrowly ellipsoid, pale shining yellow, attached near the base by very short caudicles to the shining red brown pollen carrier. *Style-apex* pentagonal, top flattened, depressed. Ripe fruit unknown.

PAHANG: Bukit Cheras, about 15 miles W.N.W. of Kuantan, at base of limestone cliff, *Henderson 25204* (type); flrs. white, in October.

KELANTAN: Gua Ninik, near the railway line close to the Pahang boundary, on limestone, *Henderson 19583;* flrs. white, in October.

LOGANIACEÆ.

Fagraea calcarea, sp. nov. **(Plate XXVIII B).**

F. Curtisii, King et Gamble similis, sed foliis pro rata latioribus et tenuioribus, calyce bracteolisque maioribus, floribus plerumque solitariis raro ternatis differt.

A *climbing shrub*. *Branchlets* stout, pale, with prominent leaf scars, striate when dry. *Leaves* thinly coriaceous, up to 17.5 cm. long and 9 cm. broad, elliptic to broadly ovate or somewhat obovate, base rather long narrowed, apex rounded with a very short abrupt triangular point; both surfaces glabrous, greenish or greenish grey when dry, minutely rugulose; midrib distinct above, prominently raised below; *main nerves* up to about 8 pairs, very faint on both surfaces when dry but visible by transmitted light, curving up to form a loop c. 1 cm. from the margin, with a fainter loop nearer the margin, tertiary

nerves and a fine close reticulation also visible by transmitted light. *Petioles* up to 1.5 cm. long, sheathing at base. *Flowers* terminal, usually solitary but sometimes in threes. *Pedicels* stout, up to 1 cm. long but usually less than half this length. *Bracteoles* 2 pairs, the outer ovate or ovate lanceolate acute up to 3 cm. long, the inner ovate rotund, 2 cm. long. *Calyx* 3.5-4 cm. long, ovate, the tube very fleshy c. 1.5 cm. long, lobes 5 unequal, ovate rotund, very fleshy, up to 2.5 cm. long and 2.2 cm. broad, the inner lobes narrowed and auricled at base. *Corolla* coriaceous, 9-10 cm. long, funnel shaped, the tube narrow at base, much widened above, c. 5 cm. long; limb 9-10 cm. across, lobes 5, broadly ovate or elliptic, apex rounded, c. 5 cm. long and 3.5 cm. broad. *Stamen* filaments slender, attached to corolla tube 2.5 cm. from its base, free portion c. 4 cm. long, anthers oblong, blunt, c. 1 cm. long. *Ovary* narrowly cylindric clavate, glabrous, longitudinally fluted, narrowed into the style, which is slightly shorter than the stamens. *Stigma* broadly funnel shaped. *Fruit* unknown.

PAHANG: Bukit Chintamani, between Bentong and Karak, climbing on a limestone rock face, *Henderson 25036* (type); flr. white, in October.

Evidently allied to *F. Curtisii*, King and Gamble, but differs in the thinner, wider and more rounded leaves, in the flowers being usually solitary or sometimes in threes and somewhat larger, and in the much larger and more deeply cut calyx.

Fagraea Sparei, sp. nov. **(Plate XXVIII A).**

F. lanceolata, King et Gamble, Mat. Fl. Mal. Pen. iv, 607, non Blume; Ridley, Flor. Mal. Pen. ii, 420.

Frutex scandens. *Folia* ad 12-13 cm. longa, ad 5.5 cm. lata, coriacea, oblanceolata, basi cuneata, apice obtusa vel breviter obtuse acuminata, sicco brunneo-nigra; costa subtus prominente, nervis lateralibus obscuris, petiolo ad 1.5-2 cm. longo. *Calyx* oblongus, c. 2.3 cm. longus; lobi 1.3-1.4 cm. longi, oblongo-ovati rotundati. *Corolla* carnosa, ad 5.5 cm. longa et 4-5 cm. lata; tubus anguste infundibuliformis, 3.5 cm. longus; lobi ovato-rotundati, 2 cm. longi, 1.7 cm. lati. *Filamenta* c. 3 cm. longa, antheris oblongis, breviter acutis, 4-5 mm. longis. *Ovarium* anguste cylindricum, cum stylo 4.5 cm. longum. *Fructus* ovoideus vel oblongo-ovoideus.

A climbing *shrub*, ? epiphytic. *Branchlets* ashy brown when dry, bark smooth. *Leaves* up to 12-13 cm. long, 5.5 cm. broad, coriaceous, oblanceolate, the base narrowed, the apex blunt or with an abrupt blunt point; both surfaces blackish brown when dry, minutely rugulose, midrib faint

above, prominent below, *main nerves* very faint or invisible. *Petiole* stout, 1.5-2 cm. long, sheathing at base. *Flowers* apparently solitary, pedicel c. 1.5 cm. long, compressed, with a pair of lanceolate or ovate bracteoles c. 0.7-1 cm. long at apex. *Calyx* oblong, c. 2.3 cm. long, fleshy, lobes apparently not spreading, 1.3-1.4 cm. long, oblong-ovate, rounded. *Corolla* fleshy, about 5.5 cm. long and 4.5 cm. wide across the limb, tube 3.5 cm. long, c. 5 mm. wide at base, narrowly funnel shaped, lobes ovate rotund, 2 cm. long and 1.7 cm. broad. *Stamen* filaments inserted 1.6-1.7 cm. above base of corolla tube, free portion c. 3 cm. long, basal part thickened for about 7 mm., gradually tapering into the slender upper part; anthers 4-5 mm. long, oblong, shortly acute. *Ovary* and style 4.5 cm. long, the ovary narrowly cylindric, tapering into the rather stout style. *Fruit* ovoid or oblong ovoid, c. 1.5 inches in diameter (ex Ridley), crowned by the rather long fragment of style.

JOHORE: Sungai Tukong Estate, *Gordon Spare F 952* (type); flr. Sept. Kluang State land, *Forest Dept. 5849* (a fragmentary specimen, but probably this species).

PERAK: Maxwell's Hill, *Wray 3202;* Larut, *Kunstler 6848.*

This species is quite distinct from *F. lanceolata* Bl., as Ridley remarks in Flor. Mal. Pen. ii, 420. It does not appear to be at all common and only rather poor material of it has been collected.

GESNERACEÆ.

Paraboea Bakeri, sp. nov.

P. ferruginea, Ridl. affinis, sed indumento haud ferrugineo, breviore, nervis et reticulationibus subtus multo magis prominentibus, inflorescentiis brevioribus, laxioribus, sepalis quam corollam brevioribus differt.

A stemless *herb,* rhizome stout with copious slender roots. *Leaves* up to 7.5 cm. long and 5 cm. broad, ovate or orbicular ovate, blunt, usually abruptly narrowed to the minutely cordate or auricled base or the base rounded and sometimes unequal; margin crenate; texture thick; upper surface bullate in life, smooth when dry in the older leaves and minutely and densely white pubescent, lower surface closely glandular papillose between the reticulations; midrib and c. 7 pairs of *main nerves* impressed and somewhat faint above, very prominent below and thick, as are the reticulations, all covered with a dense pale brown or yellowish brown matted tomentum. *Petioles* up to 4.5 cm. long, stout, densely pale brown hairy. *Inflorescences* up

to 8 or 9 cm. long, peduncles, pedicels and sepals densely hirsute with long pale brown matted hairs, in fruit glabrescent; cymes lax, fewflowered, subumbellate. *Calyx* tube very short, sepals narrow triangular lanceolate acute, 3 mm. long. *Corolla* c. 7 mm. long and 6 mm. wide across the expanded lobes, tube 3.5-4 mm. long, narrowly campanulate, puberulous, 2-lipped, lobes orbicular, the largest 2.5 mm. long and broad. *Stamen* filaments inserted near the base of the corolla tube, minutely pubescent, curved, c. 2.3 mm. long. *Anthers* orbicular oblong, c. 1.9 mm. long and 1.2 mm. broad, very lightly coherent by their apices. *Ovary* oblong, 1.2 mm. long, shortly and densely pubescent, abruptly narrowed into the rather stout style which is 3 mm. long and stiffly white pubescent in its lower two thirds. *Stigma* small, rounded. *Capsule* oblong or oblong conic acute, puberulous, c. 5 mm. long.

PAHANG: Bukit Sagu, about 18 miles N.W. of Kuantan, alt. c. 1000 ft., on bare dry limestone, *Henderson 2509* (type); flowers white with a faint pink tinge, in October.

Named after Mr. V. B. C. Baker, Sungai Lembing, Pahang.

Paraboea Bettiana, sp. nov.

P. laxa, Ridl. probabiliter affinis, sed caule longiore foliis petiolatis cordatis, inflorescentiis brevioribus haud laxis, sepalis pubescentibus haud glabris differt.

Stem woody, up to 45 cm. tall, densely softly white hairy. *Leaves* membranous, more or less crowded towards the top of the stem, up to 12 cm. long and 7 cm. broad, ovate lanceolate to ovate, apex acute, base broad, shallowly cordate or rounded and often unequal, margin deeply and coarsely serrate and softly white hairy; upper surface sparsely softly long white hairy, lower surface more sparsely so; *main nerves* 6-7 pairs, faint above, slender but raised and distinct below with long spreading white hairs. *Petioles* slender, reaching 13-14 cm., softly white hairy. *Inflorescences* numerous, up to 18 or 20 cm. long, peduncles slender, up to c. 12 cm. long, strawcoloured, softly white hairy, becoming glabrous, dichotomously branched, usually twice, the branches rather strict. *Pedicels* slender, pubescent, up to 4.5 mm. long, bracts linear caducous, 1-1.6 mm. long. *Calyx* tube short, sepals linear oblong acute, pubescent, 2 mm. long. *Corolla* 4-6 mm. long, 4.5-6 mm. across expanded lobes, 2-lipped, the upper lip of 2 ovate blunt lobes 2.5 mm. long and 2 mm. wide, lower lip of 3 similar but smaller lobes granular-glandular within, tube 2-2.5 mm. long, obconic-campanulate. *Stamen* filaments inserted c. 1 mm. from base of corolla tube and decurrent on it to the

base, free portions curved, c. 1.5 mm. long. *Anthers* quadrate, about 1 mm. across, the pair filling the mouth of the corolla tube. *Staminodes* 2, slender, clavate, c. 1 mm. long. *Ovary* conic oblong, pubescent, about 1.1 mm. long, narrowed into the style. *Style* 1.3 mm. long, pubescent, not exceeding the stamens, stigma small capitate. *Capsule* 9-10 mm. long, pubescent, narrowly cylindric oblong, style persistent.

PAHANG: Bukit Cheras, about 15 miles W.N.W. of Kuantan, alt. c. 500 ft., at mouth of limestone cave in soil kept damp by drip, *Henderson 25250* (type); flowers lilac-mauve, in October; same locality, on wet limestone rock, *Henderson 25216*.

Apparently aberrant in *Paraboea* in the presence of staminodes, but the flowers are otherwise those of this genus.

This plant bears a striking superficial resemblance to *Boea minutiflora*, Ridl., also from limestone, but it can be distinguished easily by the cordate or rounded, not attenuate leaf bases, and the straight, not twisted capsules.

Named after Mr. D. Bett, Sungai Lembing, Pahang.

Paraboea floribunda, sp. nov.

Caulis erectus, ad 10 cm. longus. *Folia* opposita, 15 cm. longa et 6 cm. lata, elliptico-lanceolata, ovata vel obovata, apice acuta, basi minute cordata; supra glabra, subtus ad costam nervosque sparse pilosa, nervis lateralibus utrinque 13-14, pagina superiore impressis, inferiore prominentibus, margine crenata, petiolo ad 1 cm. longo, dense hirsuto. *Pedunculi* communi ad 9 cm. longi, sparse hirsuti. *Pedicelli* c. 6-10 mm. longi. *Sepala* c. 4 mm. longa, linearia, sparse pilosa. *Corolla* c. 1.5 cm. lata, late campanulata, lobis rotundatis. *Stamina* 2, filamentis 1.5 mm. longis, antheris late triangularis, c. 1-1.2 mm. longis. *Ovarium* cylindrico-conicum, tomentosum, c. 2.5 mm. longum. *Stylus* 3-4 mm. longus, curvatus, stigmate obscure bilobato. *Capsula* 1.5 cm. longa, anguste cylindrico-oblonga, angulosa, minute puberula.

Stem woody, tomentose, c. 10 cm. tall. *Leaves* more or less tufted at the top of the stem, opposite, 15 cm. long and 6 cm. broad; elliptic lanceolate, ovate or obovate, apex acute, narrowed to the minutely cordate or almost auricled, sometimes unequal base; margin crenate; upper surface glabrous, pale green but darker along the veins, minutely impressed dotted; lower surface pale with long sparse reddish hairs on midrib and main nerves; *main nerves* 13-14 pairs, impressed above, prominent below, cross nervules and reticulations distinct. *Petiole* up to about 1 cm. long, reddish pink, densely hairy. *Inflorescences*

numerous, peduncles up to 9 cm. long, reddish pink with rather sparse stiff whitish hairs, in the perfect inflorescence with 2 terminal flowers, of which the uppermost opens first, and 2 branches c. 1.5 cm. long, each again with 2 terminal flowers and 2 branches c. 0.6-0.8 cm. long which bear 1 terminal and 2 lateral flowers; inflorescences often reduced by suppression of one of the terminal flowers on the secondary branches or by partial or complete suppression of the tertiary branches; bracts narrow lanceolate c. 8 mm. long. *Pedicels* variable in length, up to 1 cm. long, sparsely white hairy like the bracts. *Sepals* linear, sparsely white hairy, c. 4 mm. long. *Corolla* c. 1.5 cm. across, broadly campanulate, distinctly 2-lipped, the broad rounded lobes nearly all of the same size, but the lower lip longer than the upper one, lobes lilac, tube slightly paler, sometimes with a number of darker lines in the throat. *Stamens* inserted near the base of the corolla on slight swellings, filaments stout, 1.5 mm. long, anthers broadly triangular, coherent at apices, c. 1-1.2 mm. long, connective broad and ridged. *Disc* a very short fleshy ring round base of ovary adherent to the sepals. *Ovary* green, white tomentose, cylindric conic, c. 2.5 mm. long, tapering into the rather stout curved 3-4 mm. long style. *Stigma* green, obscurely bilobed. *Capsule* narrowly cylindric oblong, angled, 1.5 cm. long, sparsely and minutely puberulous.

Described from living plants in cultivation.

KEMAMAN: Bukit Kajang, Sungai Nipah, *Corner 26022* (type).

Probably related to *P. Curtisii*, Ridl., and *P. obovata*, Ridl., but not similar to any other described species from the Malay Peninsula.

This is a most attractive and very floriferous plant not difficult to cultivate. One specimen grown in the Botanic Gardens, Singapore, had no fewer than 29 erect umbellately arranged inflorescences each bearing on an average about 10 faintly scented flowers. A fully developed inflorescence will bear 18 flowers, but usually a number of flowers are suppressed.

VERBENACEÆ.

Clerodendron hispidum, sp. nov. **(Plate XXIX).**

C. langkawiense, K. & G. probabiliter affinis sed ramis pubescentibus pilis longis, foliis multo latioribus, hispidis, petiolis longioribus, calyce maiore, tubo corollae multo breviore differt.

A *shrub* c. 1-1.5 metres tall. *Branchlets* terete, densely yellow hispid when dry, finely longitudinally ridged. *Leaves* chartaceo-membranous, up to 24 cm. long and 10 cm. broad, elliptic or oblong ovate, the broadest part occasionally above the middle, apex long acuminate, base rounded or very shallowly cordate or sometimes attenuate; margins rather irregularly sinuate dentate or almost entire, hispid; upper surface drying brown or blackish brown, lower usually paler, both hispid with rather sparse pale hairs which are dense on the midrib and main nerves; midrib distinct but not prominent above, bold below; *main nerves* 7-8 pairs, rather indistinct above, raised and distinct below, the basal pair usually at a more acute angle to the midrib than the others, the next 3 or 4 pairs usually almost straight than gently curving along the margin, the uppermost pairs emerging from the midrib more obtusely, often almost at right angles, then curving abruptly upwards; the looped intramarginal nerve usually indistinct; transverse nervules distinct below, distant, more or less horizontal, reticulations lax, rather faint. *Petioles* 3-8 cm. long, stout, densely hispid, often longitudinally ridged when dry. *Panicles* terminal, thrysoid, pyramidal, up to 25 cm. long, densely yellow hispid, bracts leaflike, progressively smaller from below upwards, branches 1.5-2.5 cm. apart, c. 1.25-2 cm. long, bearing rather densely flowered trichotomous cymes, the peduncles and pedicels with dense multicellular hairs, bracts and bracteoles long linear subulate. *Pedicels* c. 0.5-1.2 cm. long, occasionally shorter, thickened at apex. *Calyx* 10-11 mm. long, campanulate, lobes ovate lanceolate acute, 8-9 mm. long, outside with very long stiff multicellular hairs especially on the mid-rib, nerves and margin, glabrous within, 5-nerved. *Corolla* tube cylindric, slightly expanded at base, c. 13 mm. long, c. 2.7 mm. in diameter at base and c. 1.6 mm. near apex, scabrid puberulous outside except at base, shortly and sparsely glandular hairy within, lobes oblong ovate or somewhat obovate, rounded, subequal, c. 4.5 mm. long and 3 mm. broad, the midlobe of lower lip somewhat narrower than the others and subacute, glabrous within, densely hispid pubescent without. *Filaments* exsert, slender, glabrous, c. 13 mm. long, anthers ovate blunt c. 1.6 mm. long and 0.6-0.7 mm. broad. *Style* slender, glabrous, c. 20 mm. long, stigmatic lobes slender, subulate, tapering, c. 1 mm. long. *Ovary* rounded, glabrous, shallowly lobed. *Fruit* unknown.

PAHANG: in lowland forest near the limestone hill Bukit Sagu, Kuantan district, *Henderson 25085* (type); flr. October, corolla yellow, calyx red hairy.

MYRISTICACEÆ.

Horsfieldia bracteosa, sp. nov. **(Plate XXX).**

H. sucosa, Warb. affinis, sed foliis maioribus, panicula rufo-pubescentia, bracteis conspicuis, subpersistentibus, antheris paucioribus differt.

A *tree* c. 12-.3 metres tall. *Branchlets* stout, glabrous, pale grey brown, with raised longitudinal ridges. *Leaves* up to c. 28 cm. long and 8.5 cm. broad, lanceolate, ovate lanceolate or slightly oblanceolate, apex acute, base narrowed; both surfaces glabrous; when dry the upper usually blackish or greenish brown, the lower dull red brown or pale brown; margins revolute; midrib prominent below; *main nerves* up to 14 pairs, usually inconspicuous on the upper surface, distinct below, at first straight, then curving up to and along the margin, sometimes forming loops, transverse nervules few and very inconspicuous. *Petiole* stout, black, rugulose, bordered by the decurrent margins of the leaf blade. ♂ *flowers* numerous in branched panicles from axils of fallen leaves, up to 13 cm. long, the rachis black, flattened and finely longitudinally ridged when dry, minutely rufous pubescent, sparsely so on the older parts, densely on the ultimate branchlets; branchlets terminating in umbellate cymules of 3 flowers, each cymule subtended by a conspicuous subpersistent bract; bracts variable in shape, ovate blunt or lanceolate subacute, up to 3.2 mm. long and 1.8 mm. broad, rufous hairy on edges and black dotted. *Perianth* depressed globose, glabrous, c. 1-1.3 mm. long and 1.2-1.7 mm. broad, segments 3, glabrous within. *Pedicel* 1.1-1.2 mm. long, glabrous. *Androecium* shortly stipitate, broad depressed globose, anthers 7, connate for their whole length, their apices inflexed. ♀ *flower* and fruit unknown.

PAHANG: Tembeling, in lowland forest to west of railway station, on calcareous soil, *Henderson 24521* (type); flr. May.

Easily distinguished from other Malay Peninsular species of similar habit by its large conspicuous bracts.

LAURACEÆ.

Endiandra Holttumii, sp. nov. **(Plate XXXI).**

A *E. Kingiana*, Gamble foliis pro rata angustioribus, tenuioribus, glabris, paniculis longioribus, floribus maioribus distinguenda.

A *tree* c. 16-17 metres tall. *Branchlets* terete, glabrous, pale whitish grey or brown, longitudinally striate, youngest branchlets angled. *Leaves* chartaceo-coriaceous, up to 19

cm. long and 8 cm. broad, oblong lanceolate to elliptic, apex shortly acute, base cuneate; both surfaces glabrous, the upper shining brown when dry, the lower dull, paler; midrib somewhat impressed or flattened above, raised below; *main nerves* up to 12 pairs, distinct on both surfaces, raised below, almost straight at first then gently curving up to and along the margin, tertiary nerves irregular, the cross nervules distinguishable from but not more prominent than the fine areolate reticulations which are raised on both surfaces; *petiole* stout, black, rugose, up to 1.8 cm. long. *Panicles* dense, axillary or terminal, up to 7-8 cm. long, rachis golden pubescent; *pedicels* rather stout, red pubescent, c. 2 mm. long; bracts caducous; buds ovoid, bluntly pointed, rufous pubescent, 3.5 mm. long, 2.5 mm. wide. *Perianth* tube densely red pubescent, c. 1 mm. long, lobes fleshy, cream coloured in life, the 3 outer larger than the 3 inner, one outer lobe usually larger than the other two, 4 mm. long, 2.5 mm. broad, ovate oblong or ovate, blunt or subacute, margin thin, red pubescent, glabrous within except for a rufous granular glandular patch at base and a few rufous glandular hairs near apex and on midrib; inner lobes oblong lanceolate, more or less acute, 4 mm. long, 1.5 mm. broad, glabrous except at base or densely rufous granular glandular within; lobes reflexed in anthesis. *Stamens* 3, 2-2.2 mm. long, rufous glandular pubescent, thick, triangular conoidal, narrowing to just above anthers then widening to a broad triangular blunt point, connivent and enclosing ovary; *anther-cells* c. 1 mm. long, narrow, distant, immersed in the connective, lids curling upwards and outwards. *Ovary* pyramidal, 3-angled, c. 1.2 mm. long, glabrous; *style* very short, stigma blunt, rounded. *Fruit* unknown.

PAHANG: Sungai Tekal, between railway line and the Pahang river, on stream bank, *Holttum 24679* (type); flr. April.

A specimen in rather young bud collected at Rompin, Pahang by the *Forest Dept. (No. 17114)* is most probably referable to this species.

EUPHORBIACEÆ.

Sauropus calcareus, sp. nov.

Frutex parvus, glaber, multi-ramosus. *Folia* glabra, orbiculata, late oblongo-ovata vel ovata, apice rotundata vel minute emarginata, basi rotundata vel minute cordata, ad 3 cm. longa et 2.5 cm. lata, nervis lateralibus c. 6-jugis,

indistinctis, reticulationibus conspicuis, petiolo ad 1-1.5 mm. longo. *Stipulae* acutae, persistentes, ad 1 mm. longae. *Flores* ♂ : pedicelli capillacei, ad 8 mm. longi, apice incrassati; calyx ad 2 mm. latus, breviter 6-lobus; columna staminalis brevissima. *Flores* ♀ : pedicelli ad 2-3 mm. longi; calyx campanulatus, fere ad basin 6-lobus, lobis late obovatis, brevissime apiculatis. *Ovarium* subglobosum, trigonum, c. 1 mm. longum. *Capsula* depresso-globosa, c. 4.5 mm. diameticus.

A low much branched *bush*. *Branchlets* glabrous, bark black and winged, the youngest twigs brown and striate. *Leaves* thin, glabrous, alternate, orbicular, broadly oblong ovate or ovate, apex rounded or sometimes very slightly emarginate, base round or minutely and shallowly cordate, up to 3 cm. long and 2.5 cm. wide, upper surface pale greenish when dry, the lower more or less glaucous; *main nerves* about 6 pairs, faint on both surfaces, almost at right-angles to the midrib, straight, and interlooping at two-thirds of the distance to the margin, reticulations raised on both surfaces, thicker and much more prominent than the main nerves, especially towards the margin. *Stipules* very small, acute, persistent, up to 1 mm. long. *Petiole* short, 1-1.5 mm. long. ♂ *flowers* on very short densely bracteate axillary tubercles, bracts broadly triangular ovate acute, dentate, c. 1 mm. long, the inner ones narrower. *Pedicels* capillary, up to c. 8 mm. long, apex thickened. *Calyx* shallowly saucer shaped, c. 2 mm. in diameter, black when dry, scarlet in life, margin 6-lobed, the lobes broad and shallow and somewhat irregular, disc lobes 6, acute, prominent in the young flower and enclosing the staminal column. *Staminal* column very short and broad. ♀ *flower:* pedicel 2-3 mm. long, stouter than in the ♂ ; calyx campanulate or probably eventually saucer shaped, c. 1.9 mm. long and 1.5 mm. broad, when spread out c. 3.5 mm. across, 6-lobed nearly to base, lobes subequal, broadly obovate, shortly apiculate. *Ovary* sessile, subglobose, trigonous, c. 1 mm. long, styles 3, adnate to top of ovary for almost all their length, only the bifid recurved tips free. *Capsule* somewhat depressed globose, c. 4.5 mm. in diameter, black when dry, seeds straw coloured.

PAHANG: Gunong Senyum, on limestone, alt. low, *Henderson 22316* (type) ; flr. and fruit July.

Very distinct in its pale round leaves with their conspicuous reticulation.

Richeriella malayana, sp. nov. **(Plate XXXII).**

Ab *R. gracili*, Pax & K. Hoffm. foliis maioribus, pro rata angustioribus, inflorescentiis ♂ multo longioribus.

multiramosis, floribus pedicellatis, staminibus leviter longioribus, antheris brevioribus, inflorescentiis ♀ longioribus, ramosis, differt.

A *bush or small tree* c. 3-4 to c. 13 metres tall, glabrous. *Branchlets* terete, pale when dry, finely longitudinally striate and densely lenticellate. *Leaves* 15-28 cm. long, 4-10.5 cm. broad, lanceolate, oblong lanceolate, elliptic oblong or somewhat obovate, apex acuminate, base narrowed or rounded, margin recurved and somewhat wavy; midrib distinct above, prominent below; *main nerves* 11-13 pairs, fine but distinct and slightly raised above, raised and conspicuous below, curving up and interarching c. 0.5 cm. from the margin, with 2 further series of subsidiary loops nearer the margin; secondary nerves and cross nervules raised and distinct on both surfaces, reticulations fine but distinct. *Stipules* ovate lanceolate acute, c. 2.5-3 mm. long, peltately attached, early caducous and leaving rather conspicuous circular scars. *Petioles* stout, c. 5 mm. long. *Staminate inflorescences* up to 18 cm. long, usually from lower leaf axils but occasionally from upper ones, much branched, the secondary branches reaching 10 cm. in length, the tertiary ones up to 6 cm., all slender, flattened and striate when dry; flowers in dense glomerules from 4-10 mm. apart, up to about 8 flowers in each glomerule; bracts broadly triangular ovate acute, c. 0.7 mm. long and 0.5 mm. broad, strongly keeled on back; young buds sessile, mature flowers with a stout ridged pedicel c. 1 mm. long; *sepals* broadly ovate blunt to orbicular, concave, c. 1-1.2 mm. long, c. 1 mm. broad, margin at apex minutely irregularly dentate, aestivation quincuncial: *stamen* filaments slender, c. 2.2-2.5 mm. long, broadened at base; anthers broadly oblong ovate, c. 0.4-0.5 mm. long and 0.3-0.4 mm. broad: *disc* glands fleshy, broadly obconic truncate, c. 0.2 mm. long; *rudimentary ovary* oblong, c. 1 mm. long, cleft to below middle into 2 subulate recurved arms. ♀ *flowers* unknown. *Pistillate inflorescences* in fruit reaching c. 6 cm., often branched but not so much as the staminate inflorescences, fruiting pedicels slender, up to 2.5 cm. long; calyx persistent, of 5 triangular ovate acute reflexed lobes c. 0.8-1 mm. long and 0.6-0.7 mm. broad. *Capsule* c. 5 mm. long and 1 cm. broad, much flattened vertically, black when dry and reticulate, trilobed, dehiscent into bivalved cocci, leaving a persistent axis, seeds 2 in each coccus.

PERAK: Gunong Pondok, at base of limestone cliff, *Henderson 23790* (♀ type): ♂ flrs. June: Tambun limestone cliffs, near Ipoh, *Burkill 6281*, ♂ flr. Sept.: Padang Rengas, *Burkill 13561*, ♂ flr. June.

PENANG: Road to Balik Pulau, *Curtis 2463*, ♂ flr. July: Balik Pulau, *Ridley 9396* (type of fruit), fruit July.

PAHANG: Sungai Tawar, Pulau Tioman, *Burkill 1029*, ♂ flr. June; Pulau Tioman, *Kloss sine num.*, ♂ flr. June.

?MALACCA: *Cantley's collector 2247;* fruit Sept.

Cantley's collector gives the Malay name *Pokok Surangkeng*, and notes that it is used for rafters and firewood. The plant is usually a bush or a small bushy tree, but may reach 40 feet (fide Curtis). The male flowers are usually green, but Curtis notes them as white.

The genus *Richeriella* was erected by Pax and K. Hoffmann in Engler, Pflanzenreich 81 (1922) 30 for a plant described by Merrill under the name *Baccaurea gracilis* from Palawan, Philippine Islands, and hitherto has been known only from this locality.

The specimens quoted above were found to have been distributed doubtfully between the following genera in the herbaria at Kew and Singapore:—*Antidesma*, *Actephila* and *Kunstlerodendron* (Euphorbiaceae) and *Maesa* (Myrsinaceae).

Aporosa microstachya, Muell. Arg. in DC. Prodr. xv, 2 (1866) 474; Pax & K. Hoffm. in Engl. Pflanzenreich Euphorb.-Phyllanthoid.-Phyllanth. (1922) 102.

NEGRI SEMBILAN: Gunong Tampin, *Goodenough 1895*, *Burkill 3159*. Distrib: Burma, Mergui, Tongkah.

Aporosa selangorica, Pax & K. Hoffm. in Engl. Pflanzenreich Euphorb.-Phyllanthoid.-Phyllanth. (1922) 105.

PERAK: sine loc., *Scortechini sine num.*

SELANGOR: Ulu Gombak, *Burn-Murdoch 119*, *Symington C. F. 20501*, *Sanger-Davies C. F. 2279*, *Jaamat C. F. 11192;* Bukit Enggang, Kajang, *Symington C. F. 24137;* Dusun Tua, *Ridley sine num.;* Klang Gates, *Ridley 13385* (type).

PAHANG: Pulau Chengei, Pahang river, *Ridley 2288;* Tembeling, *Henderson 21773;* Jerantut, *Holttum 24748;* Gunong Senyum, *Henderson 22307*.

These two species are not included in Ridley's Flora of the Malay Peninsula.

Blumeodendron Tokbrai, J. J. S. in Mededeel. Dept. Landbouw, x (1910) 12, 460.

PERAK: Waterfall, Larut, alt. 300 ft., *Wray 3279;* fruit October.

PAHANG: Tembeling, *Henderson sine num.;* fruit May.

JOHORE: S. Sedili, *Corner sine num.* "Tree c. 60 ft. high in swamp jungle."

SINGAPORE: Reservoir jungle, *Corner sine num.;* fruit March.

A note by Sir George King on *Wray 3279* reads: "Sir Joseph Hooker doubts this being the true *Mallotus Tokbrai* of Blume."

Although the specimens quoted are in fruit only, there can be little doubt that they are correctly placed in *B. Tokbrai*. Wray's specimens were not taken up in the Flora of British India, and as they were preserved in the Wray Herbarium in Taiping they were presumably not seen by Ridley and not mentioned by him in his Flora of the Malay Peninsula.

Sumbaviopsis albicans, J. J. S. in Mededeel. Dept. Landbouw, x (1910) 12, 357.

PAHANG: Tembeling, in lowland forest to west of railway station, on calcareous soil, *Henderson 24526;* fruit May.

This plant has not hitherto been recorded from the Malay Peninsula. It is known from Sumatra, Java, Borneo and the Philippines.

Excoecaria oppositifolia, Griff. in Calcutta Journ. Nat. Hist., iv, 386; Hook. fil., F.B.I. v, 474.

PERAK: Gunong Pondok, alt. c. 200 ft., *Henderson 23794;* fruit June. Also collected by Scortechini, without locality, number or date, probably in Perak; this specimen was found in the Indian covers at Kew, which accounts for the fact that the species has not hitherto been recorded from the Peninsula. Distrib: India and Burma.

ZINGIBERACEÆ.

Alpinia Burkillii, Hend., in Gard. Bull. S.S., iv (1927) 55. This must be regarded as synonymous with **Alpinia pahangensis,** Ridl., Flor. Mal. Pen. iv (1924) 282, although the published descriptions would indicate some differences in the flower structure. The correct name for this plant is now **Languas pahangensis** (Ridl.) Hend.

LOWIACEÆ.

Orchidantha calcarea, sp. nov.

O. longiflorae, Ridl. habitu affinis, sed foliis pro rata angustioribus, floribus minoribus, staminibus quam petalis brevioribus, stigmatis irregulariter breviter dentatis differt.

A tufted plant with thick fleshy roots. *Leaves* lanceolate acute, margin wavy, up to 73 cm. long including petiole,

and up to 7 cm. wide, petiole c. 24 cm. long, channelled above and bordered by the decurrent margins of the blade, sheathing; midrib depressed above, prominent below, nerves and reticulations indistinct. *Flowers* in pairs, axillary. *Bract* c. 4.5 cm. long, sheathing, apiculate, greenish purple. *Calyx* tube c. 8 cm. long, white, faintly tinged pink, lobes c. 6 cm. long and 1.5 cm. wide, linear oblong apiculate, blackish purple, yellowish green at base, spreading, margins more or less revolute. *Petals* 2.8 cm. long, linear, long acuminate, white with a few reddish purple lines near the margin; lip c. 5.5 cm. long and 2.5 cm. wide, the claw dark purple, edges overlapping and enclosing the petals and stamens, when spread out c. 2 cm. wide; the limb obovate, creamy white, strongly rugose with raised rugulose veins running from the claw and becoming thicker and branched in the limb, the tip with a triangular sinus 1.4 cm. deep into which the very broad, raised and rugulose papillose midrib projects as a tapering smooth subulate point somewhat exceeding the lobes. *Stamens* c. 1.3 cm. long, pale cream colour, base of filament slightly dilate and purple, apex rounded blunt, anthers linear c. 7-8 mm. long; pollen grains oblong, rounded at both ends, sometimes somewhat reniform, smooth, white, semitransparent, 150-200 μ long and 75 μ wide. *Style* slender, white, c. 1.1 cm. long. *Stigma* fleshy, vulviform, with three obtriangular arms, the centre one 6 mm. long, the side ones 4 mm. long, margins involute, truncate and shortly and irregularly dentate at apex, purple on outer face, white with a purple rim within.

Described from living plants in cultivation.

UPPER PERAK: Lenggong, near the limestone hill Gunong Runto, abundant at one point, *Henderson 26023* (type). Plants were brought back alive to Singapore (Accession No. 72/30) in June 1930, but it was not until October 1932 that they flowered.

Although the flowers are striking by reason of the contrast between the deep purplish black of the sepals and the creamy white of the lip, they are not conspicuous, being borne at ground level and hidden by the leaves. They have rather an unpleasant odour.

This species can be distinguished at a glance from both the other Peninsular species—*O. longiflora*, Ridl. and *O. maxillarioides*, Ridl.—by its relatively narrower leaves, long narrowed and decurrent on the petiole and by the distinctly wavy margin of the blade.

INDEX.

Names of new species in Clarendon, of synonyms in italics. An asterisk denotes an illustration.

PAGE.

Abrus mollis, Hance..... 99
Acanthopanax malayana, Hend.*..... 105
Aglaia tembelingensis, Hend.*..... 94
Ainsliaea reflexa, Merr..... 108
Alangium Kurzii, Craib..... 107
Alpinia Burkillii, Hend..... 125
„ *pahangensis*, Ridl..... 125
Aporosa microstachya, Muell. Arg..... 124
„ selangorica, Pax & K. Hoffm..... 124
Bauhinia decumbens, Hend..... 99
Blumeodendron Tokbrai, J. J. S..... 124
Cipadessa baccifera, Bl..... 94
Clerodendron hispidum, Hend.*..... 118
Connarus euphlebius, Merr..... 99
Desmodium lasiocarpum, DC..... 99
Dysoxylum Corneri, Hend..... 92
„ **undulatum**, Hend.*..... 90
Endiandra Holttumii, Hend.*..... 120
Excoecaria oppositifolia, Griff..... 125
Fagraea calcarea, Hend.*..... 113
„ *lanceolata*, King & Gamble..... 114
„ **Sparei**, Hend.*..... 114
Goniothalamus tortilipetalum, Hend.*..... 88
Gymnema flava, Ridl..... 111
Horsfieldia bracteosa, Hend.*..... 120
Keenania modesta, Hook. fil..... 107
Languas pahangensis (Ridl.) Hend..... 125
Lasianthus scalariformis, King & Gamble*..... 107
Medinilla crassiramea, Hend.*..... 103
Meliosma rufo-pilosa, Hend.*..... 96
Marumia dimorpha, Craib..... 104
Myriophyllum sp..... 103
Orchidantha calcarea, Hend..... 125
Paraboea Bakeri, Hend..... 115
„ **Bettiana**, Hend..... 116
„ **floribunda**, Hend..... 117
Parinarium latifolium, Hend..... 102
Pistacia malayana, Hend.*..... 97
Pratia montana, Hassk..... 108
Pygeum odoratum, Hend.*..... 101
Richeriella malayana, Hend.*..... 122
Sauropus calcareus, Hend..... 121
Schefflera musangensis, Hend.*..... 105
Sonerila capitata, Stapf & King..... 105
„ *Whittyi*, Hend..... 104
Spatholobus compar, Craib..... 99
Sumbaviopsis albicans, J. J. S..... 125
Sycopsis sp..... 103
Toxocarpus glabrescens, Hend.*..... 109
„ **pauciflorus**, Hend.*..... 110
Tylophora calcicola, Hend.*..... 111
„ Ridleyi, Hend..... 111
Urceola montana, Hend.*..... 108
Vigna malayana, Hend..... 99
„ *parviflora*, Ridl..... 99
Wendlandia ternifolia, Cowan..... 108
Xylopia tembelingensis, Hend.*..... 89

EXPLANATION OF PLATES.

(Except where otherwise stated, the figures of flowering or fruiting branches are a little less than half natural size.)

PLATE XV. **Goniothalamus tortilipetalum**, Hend.

PLATE XVI. **Xylopia tembelingensis**, Hend. 1, flowering and fruiting branch. 2, bracteole and pedicel x c.7. 3, flower with petals removed x c.7. 4, longitudinal section of fruit.

PLATE XVII. **Aglaia tembelingensis**, Hend. 1, flowering branch. 2, flower buds x c.4.5. 3, part of staminal tube with 2 inflexed anthers x c.20.

PLATE XVIII. **Meliosma rufo-pilosa**, Hend. 1, leaf and inflorescence. 2, tip of branchlet. 3, flower x c.10. 4, outer petals x c.10. 5, fertile stamen and inner petal x c.20. 6, ovary, style and disc x c.20.

PLATE XIX. **Pistacia malayana**, Hend. 1, leaf, and ♀ inflorescence c. nat. size. 2, ♀ flower x c.25.

PLATE XX. **Pygeum odoratum**, Hend.

PLATE XXI. **Medinilla crassiramea**, Hend. 1, branch and inflorescence. 2, flower bud x c.5. 3, stamen x c.10.

PLATE XXII. **Schefflera musangensis**, Hend. 1, fruiting branch. 2, flower x c.4. 3, fruit x c.2.5.

PLATE XXIII. **Acanthopanax malayana**, Hend. Flowering branch. Flower x c.10.

PLATE XXIV. **Lasianthus scalariformis**, King & Gamble. 1, flowering and fruiting branch x c.½. 2, flower x c.6. 3, corolla opened out x c.6.

PLATE XXV. **Urceola montana**, Hend. 1, flowering and fruiting branch. 2, flower bud x c.10. 3, flower x c.10. 4, stamen from inside x c.23. 5, stamen from outside x c.20.

PLATE XXVI. **Toxocarpus glabrescens**, Hend. 1, flowering branch. 2, bud and expanded flower x c.3. 3, staminal column and style apex x c.15.

PLATE XXVII. **Toxocarpus pauciflorus**, Hend. 1, flowering branch c. nat. size. 2, flower x c.5. 3, staminal column and style apex x c.20.

PLATE XXVIII. A. **Fagraea Sparei**, Hend. 1, flower bud; 2, opened corolla; 3, pistil; all x c.5/6.

B. **Fagraea calcarea**, Hend.

PLATE XXIX. **Clerodendron hispidum**, Hend. 1, calyx x c.4. 2, corolla x c.4.

PLATE XXX. **Horsfieldia bracteosa**, Hend. 1, flowering branch. 2, flower buds x c.10. 3, androecium x c.20.

PLATE XXXI. **Endiandra Holttumii**, Hend. 1, flowering branch. 2, part of lower surface of leaf showing reticulation. 3, expanded flower x c.5. 4, ovary and 2 stamens x c.10. 5, stamen x c.10.

PLATE XXXII. **Richeriella malayana**, Hend. 1, branch with ♂ inflorescence. 2, ♂ flower x c.10.

Plate 15.

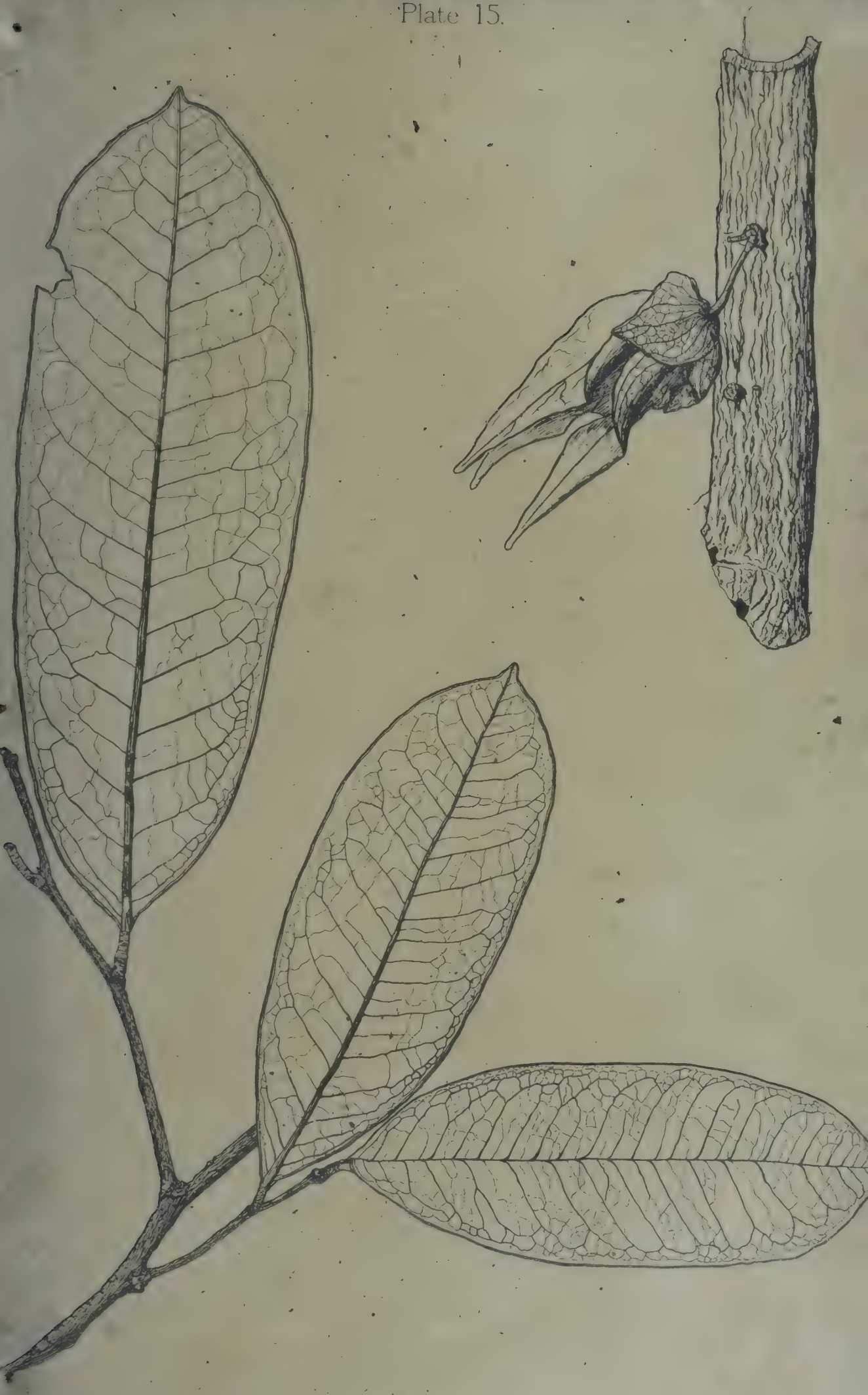


Plate 16.

Plate 17.

Gard. Bull. S.S. Vol. VII.

Plate 18.

Gard. Bull. S.S. Vol. VII.

Plate 19

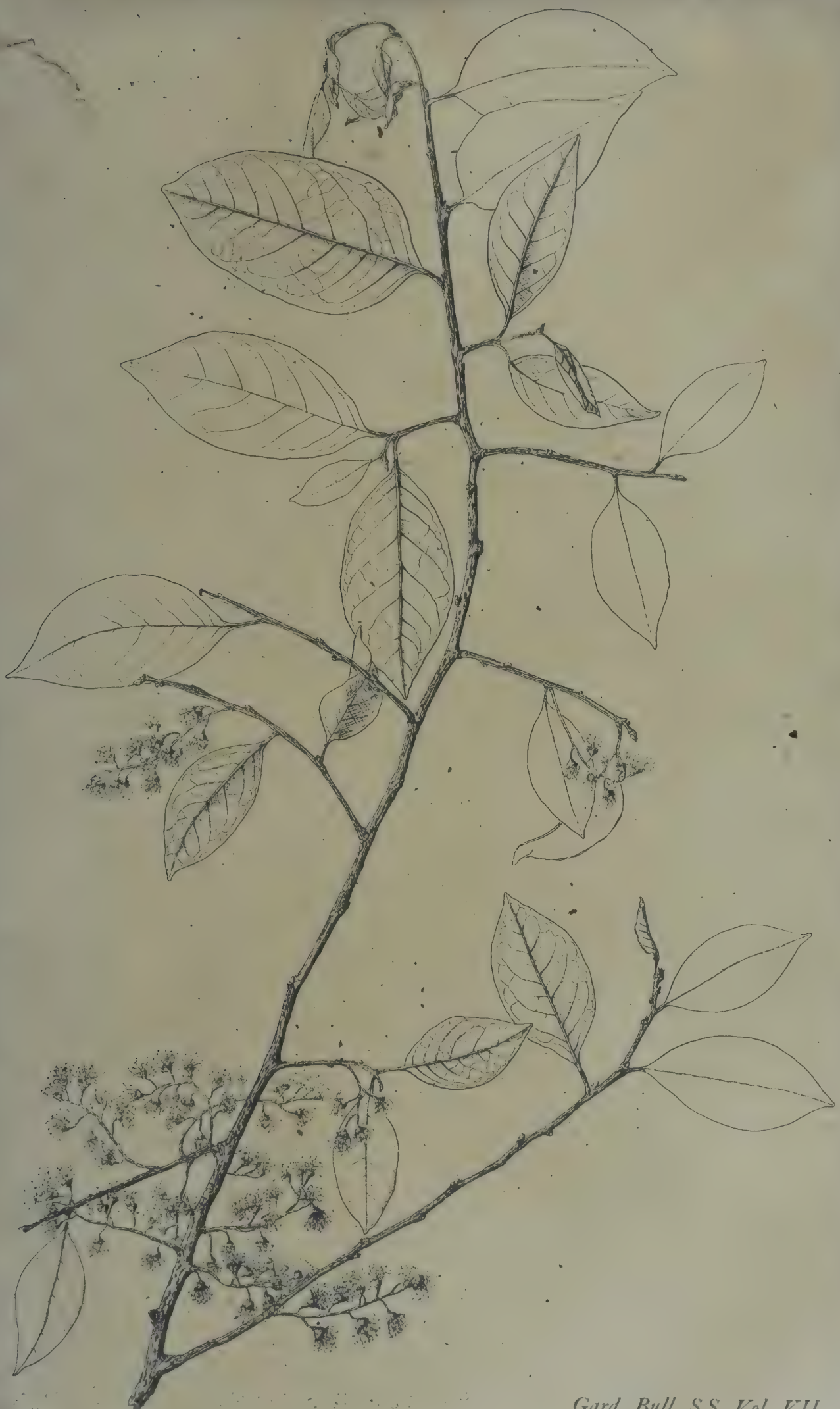


Plate 21.

Plate 22

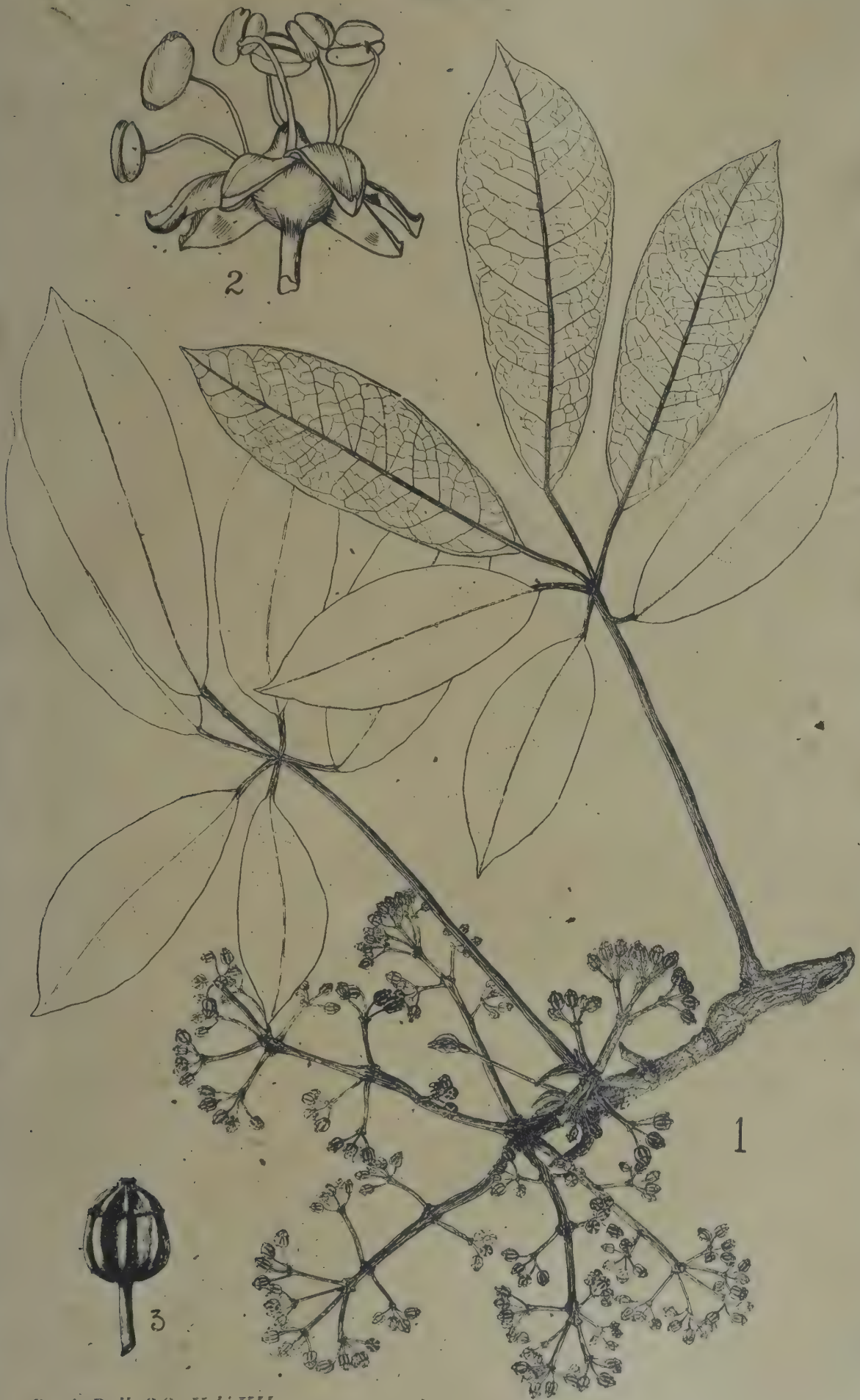


Plate 23.

Plate 24.

Gard. Bull. S.S. Vol. VII.

Plate 25.

Gard. Bull. S.S. Vol. VII.

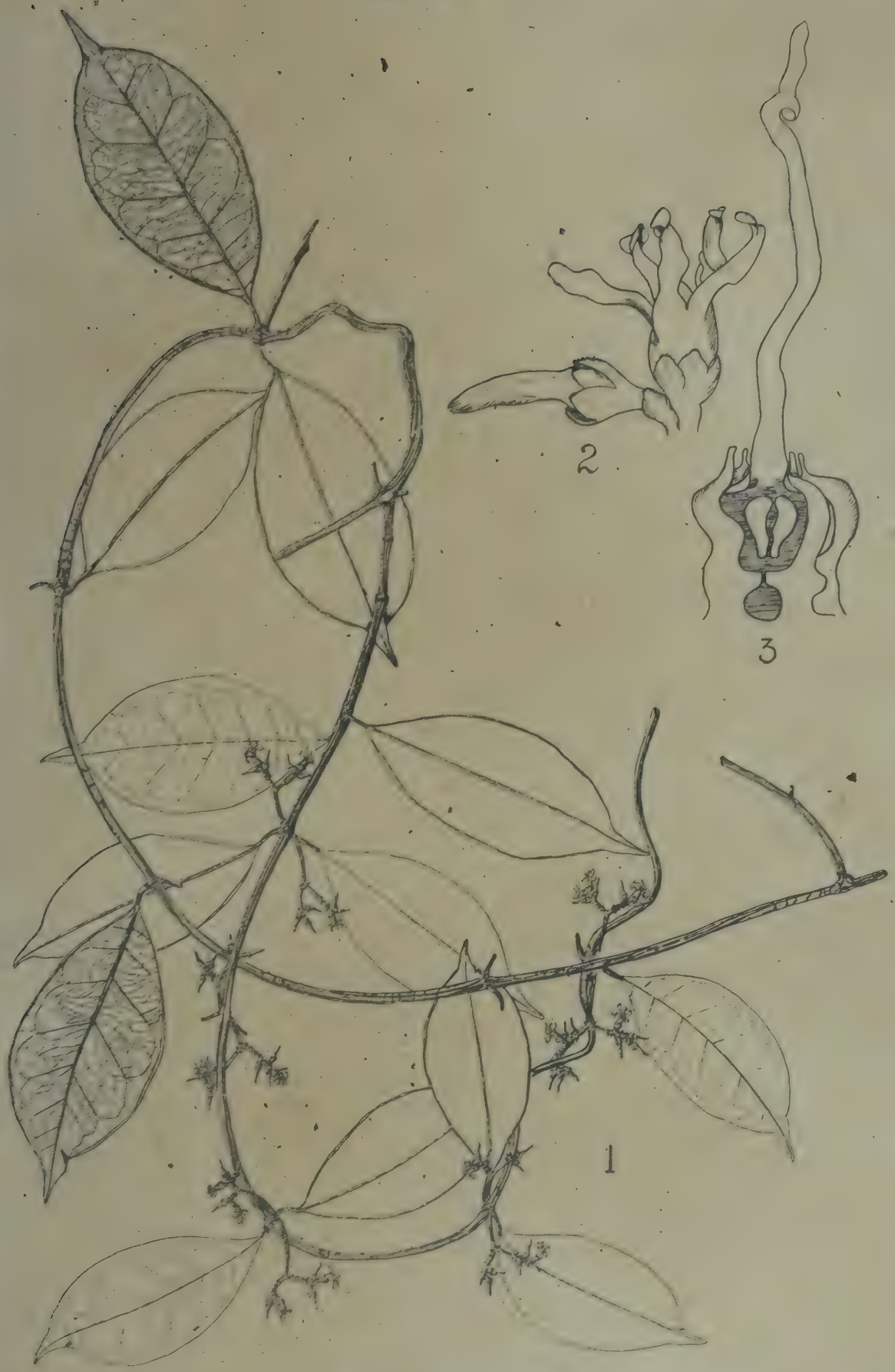
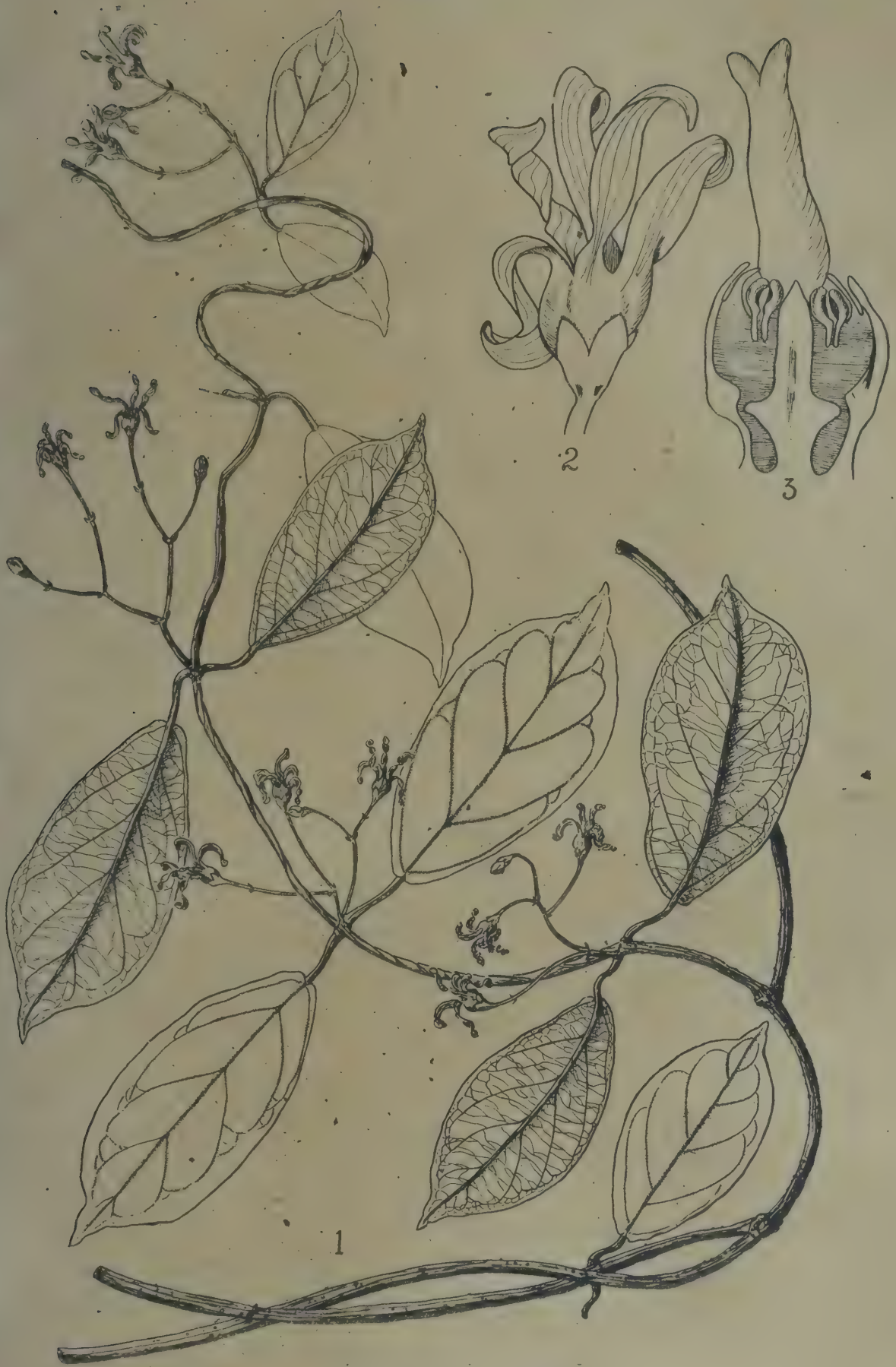
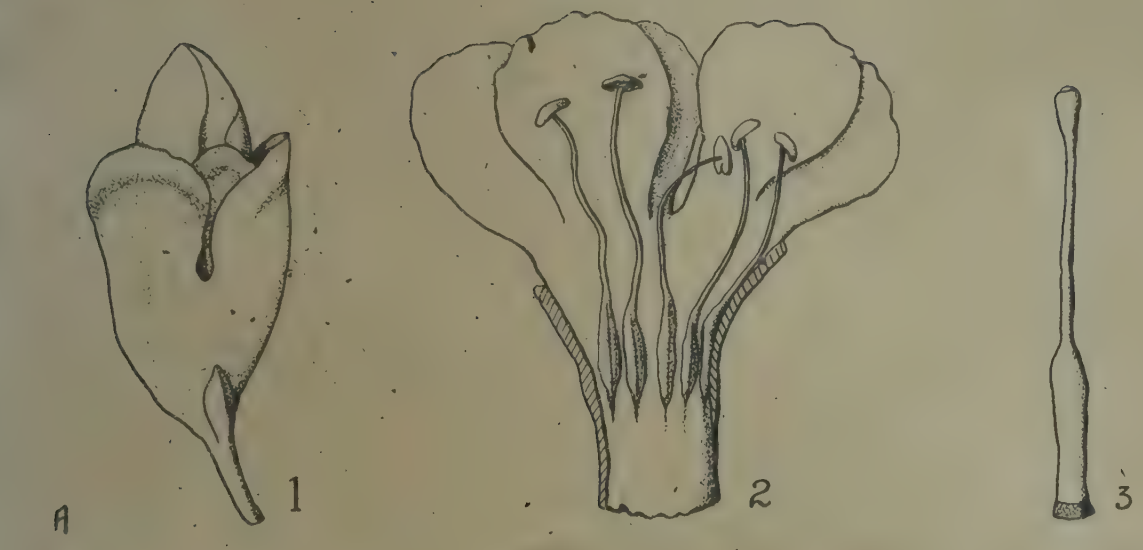

2
3
1

Plate 27.



Gard. Bull. S,S. Vol. VII.

Plate 28.



B

Plate 29.

Plate 30.

Gard.-Bull. S.S. Vol. VII.

Plate 31.

Gard. Bull. S.S. Vol. VII.

Plate 32.

1

2

Notes on Malayan Dipterocarpaceae—I.

By *C. F. Symington*, B.Sc., Asst. Forest Research Officer, Malayan Forest Service.

For some months during 1932, by the courtesy of the Director of the Royal Botanic Gardens, Kew, I had the opportunity of studying the *Dipterocarpaceae* in the herbarium there. Examination of the type material reveals the necessity for re-adjustment of our conception of the botanical status of some of our trees and considerable reduction to synonymy with the consequent alteration of some of the accepted names.

I am dealing in this number mainly with some of our species of *Shorea* but include also *Balanocarpus multiflorus*, which is more closely related to a group of Shorea including *S. Faguetiana* and *S. hopeifolia* than to some of the other species of its genus, and has therefore been studied here.

With the synonymy I have given any references to literature or iconography affecting the argument or which may help to a clearer understanding of the species through description or figure. In many cases I have added short descriptive notes which seem to me desirable for a more complete understanding of the botanical characters of the species. The concluding paragraph of the notes under each species is for the benefit of Malayan Forest Officers who are concerned less with the details of synonymy than a botanical name for the trees they meet in the jungle.

The majority of the drawings of leaves and inflorescence are by Mr. Wong Sze Moy of the Forest Research Institute, Kepong. The drawings of the flower parts I have done myself.

I am particularly grateful to Mr. Henderson of the Herbarium, Singapore, for assistance in the publication of these notes and to Dr. van Slooten of Buitenzorg for most generously lending me valuable type sheets.

Shorea Hemsleyana, King, MSS. in herb. Calcutta; Foxworthy, Mal. For. Rec. 10 (1932) 167, in part: *Balanocarpus Hemsleyanus*, King, Journ. Asiat. Soc. Bengal, lxii. 2 (1893) 134, & Ann. Bot. Gdns. Calcutta, V, 2 (1896) 160, pl. 193; Brandis, Journ. Linn. Soc. xxxi (1895) 109: *Shorea grandiflora*, Brandis, l.c. 93; *Pachychlamys Hemsleyanus*, Ridley, Flora Mal. Penin. I (1922) 234.—**Plate XXXIII.**

This species was first described by King in 1893 from several collections made in Penang and Perak (Curtis 2512;

King's Coll. 5431, 6670 & 7562; Scort. 1653). He described the plant as *Balanocarpus Hemsleyanus* but added a note upon the anomalous nature of the species which had flowers more like those of a *Shorea*. In 1922 Ridley placed the species in the genus *Pachychlamys*, a genus named in manuscript by Dyer. Foxworthy in 1932 removed it to the section *Brachyptera* of the genus *Shorea* where it is most happily placed. I am reducing to synonymy with this, *Shorea grandiflora* described in 1895 by Brandis from a Bornean collection of Haviland No. 2121. There is no doubt whatever of the identity of these species although Hav. 2121 has flowers above the average size of those in our collections and has a more hairy ovary. In King's original description of *B. Hemsleyanus* he says, "Ovary elongate-conic, tomentose, tapering into a sparsely puberulous style" but Brandis and Foxworthy describe the ovary and style as glabrous and Ridley omits to mention it. Actually the ovary and style are quite glabrous in young buds but as the flower develops a fine silky pubescence appears as a ring around the upper portion of the ovary and may extend to the style.

Foxworthy's conception of the species (Mal. For. Rec. 10, 167) is not clear as he has included under *S. Hemsleyana* all our collections of *Shorea macrantha*, Brandis, a closely allied but quite distinct species. His description however is evidently based upon authentic material of *Shorea Hemsleyana* but the following addition might be made—The flowers may be as much as 1.8 cm. long. The three rows of stamens are not always evident, the two shorter rows sometimes being almost equal. The filaments are many times longer than the anthers and the connectival appendages, erect in youth and curved or deflexed in age, are about twice as long as the anthers. The ovary is glabrous in youth but becomes silky pubescent as it matures.

Collections examined—

PENANG: Curtis, 2512.

PERAK: King's Collector, 5431, 6670 & 7562; Scortechini 1653; C.F. 12001, 12002, 12018 and 12019.

BORNEO: Haviland 2121 (Type of *S. grandiflora*, Brandis).

This tree is probably not well-known to Malayan Forest Officers as all the collections in the F.R.I. Kepong are exclusively from Parit reserve in Kinta district where it is known as *chengal pasir*. With the reduction of *S. grandiflora*, Brandis to synonymy we have now to record this species also from Borneo.

Shorea macrantha, Brandis, Journ. Linn. Soc. xxxi (1895) 97; *Shorea Hemsleyana,* Foxworthy, Mal. For. Rec. 10 (1932) 167, in part, not of King.—**Plate XXXIV.**

This species was described by Brandis from a flowering collection No. 2119 of Haviland from Borneo. There is a close similarity between this species and *Shorea Hemsleyana,* King both in flower and fruit and Foxworthy has included our collections along with authentic material of the latter species. Brandis placed the species in the Section *Pinanga* but his judgment was based on the evidence of flowering material only. Fruiting collections show clearly that the species belongs to the Section *Brachyptera* as conceived by Heim.

It is possible to amplify considerably Brandis' description with the material now available.

Medium sized trees; young branches stout, covered with a dense tawny stellate tomentum. *Leaves* coriaceous, elliptic oblong, shortly abruptly acuminate, slightly inequilateral, base cordate or truncate; upper surface brown glabrous shining except along the densely tomentose midrib; lower densely ferruginous or tawny stellate tomentose or scabrid; margins slightly revolute; secondary nerves 12–17 pairs, anastomosing at the margins, inconspicuous above, prominent beneath; tertiary nerves parallel, prominent beneath; size of mature leaves very variable, 6–18 cm. long by 3–7 cm. broad; petiole up to 7 mm. densely tawny tomentose; stipules sub-falcate, persistent, tawny tomentose, broad at base, acute at apex, 5-nerved. *Panicles* axillary and terminal, racemose, up to 12 cm. long, branches short distichous each subtended by two persistent stipular bracts, all tawny tomentose; flowers 2–5, fascicled on the short branchlets, each subtended by two small more or less persistent bracts, sessile. *Sepals* 5 mm. long ovate acute stellate tomentose without, glabrous within, three rather larger than the other 2. *Petals* linear up to 2.9 cm. in mature flowers, glabrous inside, tomentose along one half outside (said to be "red and white"). *Stamens* 15 in 3 rows; filaments broad and flattened at base, those of the smallest row about 4 times as long as the anthers; appendage to connective 1–2 times as long as the anther, filiform, erect in bud becoming curved or deflexed in age. (The appendages of the largest row of stamens are usually relatively smaller than those of the other rows and are often obscured beneath the anthers in mature flowers). *Ovary* glabrous or minutely sericeous puberulous in mature flowers, narrowing into a glabrous filiform style 2–3 times as long as the ovary. Stigma deltoid. *Ripe fruit,* oblong apiculate, tawny tomentose, up to 5 cm. long by 2 cm. broad. Persistent sepals nearly equal, bases thickened woody,

slightly rugose and tawny puberulous, 2 cm. long by 1.5 cm. wide, forming a cup which embraces the lower portion of the fruit.

We have several collections of this tree from Pahang which are distinct from other collections in having leaf nerves depressed on the upper surface to give a quilt-like appearance and in that the lower surfaces of the leaves are scabrid rather than tomentose, but I can detect no essential differences in this form.

Comparison of S. macrantha, Brandis and S. Hemsleyana, King. There is a very close similarity between these species but *S. macrantha* may easily be distinguished by the smaller, more oblong, inequilateral leaf and shorter petiole and, in flower, by the long linear corolla lobes.

Collections examined—

PERAK: Singapore 13247: C. F. 0314, 1241, 8050, 8808, 9722, 9751, 10260, 10290, 10460, 10493, 10810 and 27805.

PAHANG: C. F. 3553, 15039, 15684 and 15751.

BORNEO: Haviland 2119 (Type of *S. macrantha*, Brandis).

This also appears to be a tree of comparatively restricted distribution and therefore probably not well-known to many Malayan Forest Officers. Our collections are all from flat land either in Perak where the tree is known as *chengal pasir* or from Pahang where it is known as *kepong hantu*. The occurrence of this tree in the same locality and under the same vernacular name in Perak as *Shorea Hemsleyana* is probably responsible for its confusion with that species.

Shorea rugosa. Heim, Bull. Soc. Linn. Paris (1889) 973; Brandis, Journ. Linn. Soc. xxxi (1895) 96: *Shorea verrucosa*, Dyer, MSS. in herb. Kew: *Shorea* sp., Foxworthy, Mal. For. Rec. 3 (1927) 37, with two plates: *Shorea uliginosa*, Foxworthy, Mal. For. Rec. 10 (1932) 210 and 277.—**Plate XXXV.**

The type material of *S. rugosa*, Heim was collected in Borneo by Beccari between 1865 and 1868. These collections (Becc. 2638 and 2890) do not show the cupping of the leaves seen in the type of *S. uliginosa*, Foxw. but the flower structure and texture of parts is absolutely identical.

In briefly describing this material Brandis says that the stigma is tri-partite but in all flowers I have examined the stigma has been small and either simple or minutely papillose. Otherwise Brandis' description agrees with that of Foxworthy for *S. uliginosa* to which I have little to add except that the cupping of the leaves is by no means always

evident in herbarium material; the sepals are unequal, the two inner being half the size of the three outer; the stamens are of three sizes, two relatively short rows and one long, and the connectival appendage of the smaller stamens becomes deflexed only as the flower matures.

Collections examined—

PERAK: C. F. 17065, 27803, 27819 and 27831.

SELANGOR: C. F. 0432, 3263, 7938 (Type of *S. uliginosa* Foxw.), 11001, 21968, 23228, 24865, 27065, 27696, 27872, 28381, 29051, 29052, 29053, 29059, 29060, 29101, 29102 and 29103.

BORNEO: Beccari 2638 and 2890 (Types of *S. rugosa*, Heim), Haviland 2252.

This tree is our common cup-leaved form of *meranti bakau* found in freshwater swamp. Dr. Foxworthy's name of *Shorea uliginosa* is here reduced to synonymy with *S. rugosa*, Heim from Borneo.

Shorea platycarpa, Heim, Bull. Soc. Linn. Paris, ii (1891) 956: *Shorea nigrescens*, Dyer, MSS. in Herb. Kew: *Shorea leprosula*, Boerl., Cat. Hort. Bog. (1899) 110, not of Miquel: *Shorea palustris*, Ridl., Fl. Mal. Penin. I (1922) 224; Foxworthy, Mal. For. Rec. 10 (1932) 212.—**Plate XXXVI.**

Heim's original description was drawn from a Bornean collection of Beccari (3302) bearing very young fruit. Ridley's type of *S. palustris* (C. F. 2073) has vegetative parts which are absolutely identical and fruits which are nearly mature. I have felt more confident in identifying Ridley's species with that of Heim after examining a Bornean collection of Haviland (2252) which was included under the *Shorea leprosula* cover at Kew. This bears flowers which are identical in every way with those from our collections from the peninsula.

The flower of this species has been described by Foxworthy from C. F. 0310. On his description I should like to comment that in none of the flowers examined have I found any trace of scabrities on the awns which, as in *S. rugosa*, Heim, *S. lepidota*, Bl. etc. are at first erect but later become deflexed. Also the stigma is distinctly deltoid. This is an important point as it seems to be one of the few essential differences between the flowers of this species and those of the two just mentioned.

Collections examined—

DINDINGS: C. F. 2329 and 27842.

PERAK: C. F. 14373, 24601, 24615, 27801, 27808, 27823 and 29064.

SELANGOR:	C. F. 0310, 2073 (Type of *S. palustris*, Ridl.), 2920, 15310, 15337, 17043, 17044, 17045, 27063, 29058 and 29705.
PAHANG:	C. F. 6657, 15677 and 20131.
JOHORE:	C. F. 2372.
SINGAPORE:	S'pore 406 (Cult. in Econ. Gdns.).
JAVA:	Herb. Bog. 233 (Cult. in Hort. Bog. VII–B–40).
BORNEO:	Beccari 3302 (Type of *S. platycarpa*, Heim); Haviland 2253; C. F. 28695 (Brunei).

This is the tree frequently known to Malays as *meranti kait-kait*, *meranti paya* etc. or has been referred to as "the round-leaved form of *meranti bakau*" (vide Foxworthy).

Shorea Teysmanniana, Dyer, ex Brandis, Journ. Linn. Soc. xxxi (1895) 100: *Shorea cochinchinensis*, var *oligoneura*, Boerl., Cat. Hort. Bog. (1901) 107: *Shorea paludosa*, Foxw., Mal. For. Rec. 10 (1932) 277.— **Plate XXXVII.**

The species was originally described in 1895 by Brandis from a sterile collection of Teysmann from Bangka. The unsatisfactory type specimen consists of a twig with six rather immature leaves and two buds, and it is not surprising to find that it has been overlooked by subsequent authors. The species next appeared as a fruiting collection from a tree in the Buitenzorg Gardens which was catalogued by Boerlage as *S. cochinchinensis*, var *oligoneura*. In 1932 Foxworthy described his *S. paludosa* from a fruiting collection identical with Boerlage's specimen. Haviland's collections Nos. 2255 (flower and fruit) and 2330 (flower) are the only flowering specimens I have seen.

That the above are all identical there can be no doubt. A very distinctive vegetative feature which is evident in Brandis' original type and in every other collection I have examined, is the presence of long-stalked vegetative buds.

The fruit of this species has been described by Foxworthy. The following flower description is drawn from Haviland 2255. Unfortunately when examining the specimen I omitted to make complete notes on the nature of the inflorescence.

Flowers sessile, 7 mm. across when expanded. *Sepals* ovate, acute, tomentose outside and glabrous within, three large and two smaller, the largest about 2 mm. high. *Petals* oblique oblong 6 mm. long by 1.5 mm. broad when expanded, tomentose along one side without, glabrous within.

Stamens 15 in 2 rows, the larger, of five stamens, twice as long as the smaller; filaments several times longer than the anthers, flattened, and much expanded at the base; appendage to connective of large stamens a minute awn which becomes curved and deflexed in age; appendage of smaller stamens 2–3 times as long as the anthers, at first erect, later curved. *Ovary* about 1 mm. long consisting of a lower glabrous portion and an upper finely tomentose, ridged, conical portion tapering into a style as long as the ovary and glabrous above; stigma enlarged and disc-like.

Collections examined—

SELANGOR:	C.F. 3264, 23229, 23939 (Type of *S. paludosa* Foxw.), 24566, 24567, 27064, 27069 and 29054.
BANGKA:	Teysmann (Type of *S. Teysmanniana*, Dyer) and Herb. Bog. 6591.
JAVA:	Herb. Bog. 229 (VII-C-25 in Cat. Boerl.-authentic specimen of *S. cochinchinensis* var *oligoneura*, Boerl.).
BORNEO:	Haviland 2255 and 2330.

This is the swamp tree which has been collected in the Peninsula only from Kuala Langat and Telok Reserves in Selangor where it is known as *meranti bunga*. It is here shown to be not a "new species" but one described by Dyer in 1895 as *Shorea Teysmanniana*.

Shorea lepidota (Korth.) Blume, Mus. Bot. ii (1852) 32; Brandis, Journ. Linn. Soc. xxxi (1895) 96; not of Foxworthy, Mal. For. Rec. 10 (1932) 166: *Vatica lepidota*, Korth., Verh. Nat. Gesch. Bot. (1839) 73: *Vatica ? stipulosa*, Miq. Fl. Ind. Bat. Suppl. (1860) 486: *Shorea ? nitens*, Miq. l.c. 488: *Shorea stipulosa*, Burck, Ann. Jard. Buit. VI (1887) 220: *Shorea megistocarpa*, Foxw., l.c. 216, Pl. xvii.—**Plate XXXVIII.**

This species was first described from fragmentary flowering material from Sumatra by Korthals in 1839 as *Vatica lepidota*. In 1852 Blume referred the plant to *Shorea*. In 1860 Miquel, with a sterile Sumatran collection of Teysmann's described his *Vatica ? stipulosa* which in 1887 was referred to the genus *Shorea* by Burck. Contemporaneously with his description of *V. stipulosa*, Miquel published his *Shorea ? nitens*. He evidently failed to identify these as one species because the type of *V. stipulosa*

represents the immature stage with long leaf and woolly stem rather different from the more mature stage represented by *S. nitens.*

Brandis made the reduction of *S. nitens* Miq. to *S. lepidota*, Bl. in 1895. He also states that "*S. stipulosa* Burck (= *V. stipulosa*, Miq.) may possibly belong to this species." With the material of this species now at our disposal it is possible with confidence to remove the doubt from his statement.

Van Slooten ex Heyne in Nutt. Plant. Ned. Ind. 2nd edit. (1927) 1121 gives *S. aptera*, Burck, *S. palembanica*, Miq., *S. nitens*, Miq., *S. stipulosa*, Burck, *V. lepidota*, Korth. and *V. stipulosa*, Miq. as synonyms of *S. lepidota*, Bl., but is mistaken in uniting the first two with the others. *S. palembanica* Miq., to which is reduced *S. aptera*, Burck, (see notes on *S. palembanica*, Miq.), is the tree described by Foxworthy under *S. lepidota.* It grows along stream banks and has large, short-winged fruits which are valued for their fat. *S. lepidota* (Korth.) Bl., to which the others are reduced is the quite distinct tree described by Foxworthy as *S. megistocarpa.* It has a fruit of the usual long-winged type of *Shorea.* The types of *V. lepidota* Korth., *V. stipulosa* Miq. and *S. nitens*, Miq. are superficially not unlike collections of *S. palembanica* but may be distinguished by the narrower and more oblong leaves, the somewhat shorter and more delicate petioles, the slightly flattened branchlets and the large, long-persisting, subfalcate papyraceous stipules. The type of *V. lepidota*, Korth. consists of an immature twig and a twig with peduncles which bore very young fruit all of which have fallen except on the Buitenzorg sheet. This sheet which retains three young fruit and exactly matches C.F. 636 provides the key to the identity of *S. megistocarpa*, Foxw. with *S. lepidota*, (Korth.) Bl. The type of *V. stipulosa*, Miq. consists of sterile twigs from a seedling or sapling with long, short-petioled leaves, a woolly stem and large persistent stipules. Once recognised seedlings of this species are easily distinguished. The type of *S. nitens*, Miq. is a sterile mature twig and finds an almost exact match in C.F. 26050 and others.

This tree (*S. lepidota* (Korth.) Bl.), then, is that which Foxworthy has described as *S. megistocarpa.* He has fully described the species but I should like to add the following notes—

Sepals unequal, the two inner only half the length of the three outer: *Petals* linear-oblong when fully expanded, up to 8 mm. long: *Stamens* of two heights, the five inner twice the height of the ten outer; filaments tend to be

hollowed out from the posterior as in *S. gibbosa*, appendage to connective of large stamens about as long as the anther, that of small stamens about twice as long as the anther. In young buds all appendages are erect but as anthesis approaches first those of the posterior row of stamens become deflexed and later the remainder also. *Ovary* is finely pubescent. (This is one of the few floral distinctions between *S. lepidota* and *S. rugosa*. In the latter the ovary is densely tomentose).

Collections examined—

KEDAH:	C.F. 11465 and 12219.
PERAK:	C.F. 8339, 12981, 24647, 25551 and 27225.
NEGRI SEMBILAN:	C.F. 636 and 23349.
TRENGGANU:	C.F. 26701, 26892 and 26936.
PAHANG:	C.F. 1292, 2395, 5435, 6661, 6827, 8110, 10611, 13773, 23877, 24373, 26042, 26050, 26504, 26518 and 31507.
JOHORE:	C.F. 5893 (Type of *S. megistocarpa*, Foxw.) and 6012.
SUMATRA:	Herb. Utrecht 35913 (= Herb. Bog. 797 Teysmann (Type of *S. nitens*, Miq.), 35916 (= Herb. Bog. 2076) Diepenhorst (Type of *V. stipulosa*, Miq.), 3917 sine nota, 35918 Korthals (Type of *V. lepidota*, Korth) and 72529 (= Herb. Bog. 591) Teysmann; Herb. Bog. 589 Teysmann.

This is the large *meranti* found usually on low-lying land and known sometimes as *meranti pala*. It has been described as *Shorea megistocarpa* (vide Foxworthy l.c. 217) which is here shown to be identical with the older species *S. lepidota* (Korth.) Bl. by which name it must in future be known. The name *S. lepidota* is shown to have been misapplied to what is actually *S. palembanica*, Miq.

Shorea parvifolia, Dyer, in Hook. f. Fl. Brit. Ind. i (1872) 305; King, Journ. Asiat. Soc. Beng. lxii, 2 (1893) 112 in part; Brandis, Journ. Linn. Soc. xxxi (1895) 92; Foxworthy, Mal. For. Rec. 3 (1927) 31 with 2 plates; not of Foxworthy, Mal. For. Rec. 10 (1932) 199: *Shorea scutulata*, King, l.c. 110; Brandis, l.c. 102; Foxworthy, l.c. 201.—**Plate XXXIX.**

This species was first briefly described by Dyer from three flowering collections (2549, 1577 and 1197) made

by Maingay in Malacca. These were all given the Kew distribution number 206. In 1893 King amplified Dyer's description but from the fact that he says, "apiculus of connective very slender, about as long as the anther," I am inclined to think that he did not examine authentic flowering material of *S. parvifolia*, Dyer. Actually King cites Curtis 201 under *S. parvifolia*. It is a good flowering collection and was very probably examined by him but it is not *S. parvifolia*, Dyer but the closely related *S. ovata*, Dyer (See *S. ovata*). Had King examined authentic flowers of *S. parvifolia*, Dyer it is improbable that he would have redescribed the species as *Shorea scutulata*, King. I have examined flowers of Curtis 1396 from Penang, the type of *S. scutulata*, and also flowers from the types of *S. parvifolia*, Dyer and have no hesitation in uniting these species. King in his description of *S. scutulata* makes the statement that the anthers are inappendiculate and Brandis says of that species—"in bud I have invariably found a short pointed apical appendage." In my experience the appendage is invariably present although it becomes deflexed as the flower matures and is at least twice as long as the anther.

The plant referred by Foxworthy to *S. parvifolia* is actually *S. ovata*, Dyer. Foxworthy has given a full botanical description of this species under *S. scutulata* but I should like to make the following remarks—On each branchlet of the panicle there are usually 3–5 flowers, each about 7 mm. long. *Sepals* of two sizes, the three outer, broadly lanceolate ovate obtuse, are 2–3 times as long as the two inner which are ovate acute. *Petals* when mature, 3 times as long as the largest sepals. *Antherine appendage* at first erect, becomes deflexed in age. *Ovary* consists of a glabrous basal portion and a slightly ridged sericeous upper portion considered by Brandis to be a stylopodium. The style is about the same length as this stylopodium.

Among our numerous collections of this species there is a certain amount of variation. Collections from Kedah and Perak frequently have more elongate stipules than those from Selangor, and other collections, mainly from Pahang, have more oblong leaves which are more uniformly puberulous on the under surface. In the field also I have noted that the tree in Perak appears somewhat different from what I consider to be the same species in Selangor. However after careful examination of our herbarium material I must conclude that these variations do not constitute specific distinction. Moreover Dyer's type collections are not all identical. 2549 is typical of the form found in Selangor while 1577 and 1197 represent the Pahang form.

These minor differences may therefore reasonably be considered within the range of variation of the species.

Comparison of S. parvifolia, Dyer with S. ovata, Dyer. These two species are so very much alike that an enumeration of the essential differences may be useful. The trees are less likely to be confused in the field than in the herbarium because *Shorea parvifolia* is typically a tree of the plains, while *S. ovata* is exclusively a hill form rarely seen below 1,000 ft. In the herbarium sterile specimens of *S. ovata* may be recognised by the typical ovate leaf of thicker texture and with a slightly longer petiole than *S. parvifolia*. Flowering specimens of *S. ovata* usually have more flowers on each branchlet of the raceme which are usually distichous as opposed to secund, but the only really reliable floral distinction is in the length of the antherine appendage. This in *S. ovata* is not more than the length of the anther while in *S. parvifolia* it is from 2–3 times as long as the anther.

Collections examined—

SIAM:	S'pore 24220, 24223 and 24335.
PENANG:	Curtis 1396 (type of *S. scutulata*, Dyer); S'pore 3465 and 3750; C.F. 25638 and 28044.
KEDAH:	C.F. 7597, 7608, 8901, 8911, 8979, 10054, 11466, 11469, 12226, 12597, 17753 and 17865.
PERAK:	C.F. 037, 038, 0131, 0133, 0117, 4554, 8305, 10370, 10395, 11025, 16340, 11026, 13223, 16635, 24493, 24603, 25438, 25585, 27802, 27818 and 28972.
SELANGOR:	C.F. 725, 739, 3337, 4658, 5712, 5791, 7064, 7911, 9543, 9544, 9550, 10897, 13261, 13954, 14907, 15263, 15358, 16475, 16489, 16906, 21374, 21961, 22070, 23098, 23124, 23125, 23126, 23127, 23128, 23852, 24886, 26351, 26385, 27895 and 28368.
NEGRI SEMBILAN:	C.F. 0610, 0611, 0621, 0630, 2007 and 23701.
MALACCA:	Maingay 1577, 1197 and 2549 (K.D. 206, Types of *S. parvifolia*, Dyer); C.F. 2015 and 2052.

TRENGGANU:	C.F. 26711.
PAHANG:	S'pore 24052; C.F. 1018, 1019, 1274, 1276, 1278, 4628, 4795, 4999, 5065, 5090, 5437, 5503, 5508, 5509, 6612, 8136, 8146, 10610, 10614, 14002, 15145, 17128, 23375, 23386, 23419, 26176, 28221 and 28313.
JOHORE:	C.F. 5856, 5862, 5966, 6014 and 6151.
SINGAPORE:	S'pore 634.

This is the tree usually known as *meranti sarang punai*, one of our most common softwooded Shoreas.

Shorea ovata, Dyer, ex Brandis, Journ. Linn. Soc. xxxi (1895) 91: *Shorea parvifolia*, King, Journ. Asiat. Soc. Bengal. lxii, 2 (1893) 112 in part; Foxworthy, Mal. For. Rec. 10 (1932) 199, not of Dyer in Hook. f. Fl. Br. Ind. i (1872) 305 and Brandis l.c. 92.—**Plate XL.**

The earliest cited collection of this species appears to be Curtis 201, Penang. This was included by King under *Shorea parvifolia* in 1893. In endeavouring to amplify Dyer's brief description of *S. parvifolia*, King apparently examined the best available flowering collection of what he considered to be that species i.e. Curtis 201 and described not the flowers of *S. parvifolia* but *S. ovata*. In 1895 Brandis published the first description of *S. ovata* using an MSS. name given by Dyer to a collection of Beccari (3092) from Borneo. Brandis cited also Haviland 2042 from which he gave an unsatisfactory description of the flowers of his species. He failed however to identify Curtis 201 with this species, presuming he saw the collection. Thus it is that King's error in including Curtis 201 under *S. parvifolia* has been responsible for the fact that *S. ovata* has never been recorded from the Peninsula, because subsequent authors have included our *S. ovata* material along with authentic collections of *S. parvifolia* under the last name. Foxworthy, however, has endeavoured to separate these species by confining the name *S. parvifolia* to what is actually *S. ovata* and considering the remainder as *S. scutulata*.

This species has been botanically described under *S. parvifolia* by Foxworthy but to his description I should like to add the following remarks—The flowers are more often distichously arranged than secund and there are usually 5–10 on each branchlet of the panicle. *Sepals* of two sizes, the three outer considerably longer than the two inner. *Petals* when mature at least three times as long as

the sepals. *Stamens* of three sizes, the smallest row of 5 has filaments about 4 times as long as the anthers, those of the largest row are more than twice as long while the filaments of the middle row are intermediate in height. *Ovary* consists of a glabrous basal portion and a sericeous upper portion considered by Brandis to be a stylopodium. Style is not quite as long as the hairy portion. *Ripe fruit* is usually, although not invariably, markedly beaked.

Collections examined—

PENANG: Curtis 201, 437 and four unnumbered specimens. S'pore 3301, 3341, 3463, 3691, 4330, 4569, 4578, 4902 and 9139; C. F. 11654, 11659, 11660 and 27776.

PERAK: C. F. 25430, 25523, 25569, 25750 and 25818.

DINDINGS: C. F. 27760.

PAHANG: C. F. 20353, 20447 and 23388.

BORNEO: Becc. 3092 (Type of *S. ovata*, Dyer); Haviland 2042.

This tree is typically a high hill form. Because of its habitat it is not well-known to Malays who, when they come across it, usually call it *meranti sarang punai* because of its resemblance to the common *meranti sarang punai* of the plains (*S. parvifolia*).

Shorea palembanica, Miq., Fl. Ind. Bat. Suppl. (1860) 487: *Shorea aptera*, Burck, Ann. Jard. Buit. vi (1887) 210, pl. 22: *Shorea brachyptera*, Heim, Bull. Soc. Linn. Paris, ii (1891) 957: *Pachychlamys Beccarianus*, Dyer, MSS. in herb. Kew: *Shorea lepidota*, Foxworthy, Mal. For. Rec. 10 (1932) 166; not of Blume, Mus. Bot. ii (1852) 32.—**Plate XLI.**

This species was first described as *S. palembanica* by Miquel from a sterile collection made by Teysmann in Palembang. In 1887 Burck examined Bornean collections in flower and fruit describing and figuring them as *S. aptera*, and four years later Heim re-described the tree as *S. brachyptera* from Beccari's collections from Sarawak.

I have not seen the specimens upon which Burck founded his *S. aptera*, but I have seen other collections verified by him, which, together with his published figure, leave no doubt as to his conception of the species. It is somewhat misleading however, that the leafy twig of his figure is from a sapling or, at any rate, is hardly characteristic of the mature form.

Foxworthy's *S. lepidota* is undoubtedly identical with the above. Presumably he has followed Van Slooten (ex

Heyne, Nutt. Plant. Ned. Ind. 2nd. edit. (1927) 1121) in reducing *S. aptera*, Burck to *S. lepidota* (Korth.) Bl. There has been great confusion of these species which I have endeavoured to straighten out in my notes under *S. lepidota*.

Under *Shorea Thiseltoni* (Syn. *S. singkawang* (Miq.) Burck) King has cited No. 8162 which clearly ought to be referred to *S. palembanica*, Miq.

Foxworthy, under *S. lepidota* gives an adequate description of this species but the following remarks are appropriate—The tertiary nerves of the leaf are parallel. The flowers are not reddish but yellow and are borne on a pedicel only 1 mm. long. The stamens are of three sets; the large inner row of five has filaments broadly dilated in the lower half, suddenly narrowing to the filamentous upper half; the two other rows are subequal, one row of five being borne on the backs of the inner large stamens with which the third five alternate; the filaments of these smaller stamens have a very short filamentous portion. The ovary is usually distinctly 5-ridged. All the immature fruits examined have three wings exceeding the nutlet by 1–2 cm. and two much shorter wings. The only perfectly mature specimens I have seen have had the wings broken. The nutlet is apiculate and velvety.

Collections examined—

PERAK:	King 8162 and C.F. 5696.
TRENGGANU:	C.F. 26800 and 26939.
PAHANG:	C.F. 2736 and 2741.
JOHORE:	S'pore 21184; C.F. 5905.
SUMATRA:	Herb. Utrecht 35907 (= Herb. Bog. 3681) Teysmann (Type of *S. palembanica*, Miq.); Herb. Bog. 3P/876, Irwaan.
JAVA:	Herb. Bog. 227 and sine no. "teste Burck"; Herb. Bog. sub VIII. D. 56[a] cult. in Hort. Bog.
BORNEO:	Herb. Bog. sine no., Teysmann "det. Burck," 2077 (bb. 1087) Labohm and sine no. Kuching, Hewitt; Beccari 2681, 3075 and 3507 (Types of *S. brachyptera*, Heim. [= *P. Beccarianus*, Dyer MSS.]); C.F. 390, Sarawak.

This tree is not well-known to Malayan Forest Officers. It is invariably found along stream banks and is rarely well shaped. It has been collected in Perak and Johore under the name of *sengkawang*, in Trengganu as *tengkawang ayer*, and in Pahang as *merpak*.

Shorea gibbosa, Brandis, Journ. Linn. Soc. xxxi (1895) 99: Ridley, Journ. Str. Br. R. As. Soc. 54 (1909) 23 and Flora. Mal. Penin. 1 (1922) 229; Foxworthy, Mal. For. Rec. 10 (1932) 208: *Hopea grisea*, Brandis, l.c. 63,—**Plate XLII.**

The descriptions of *S. gibbosa* and *H. grisea* were published contemporaneously by Brandis in 1895. Both were described from flowering collections, the former from Singapore by Ridley and the latter from Borneo by Beccari. It is difficult to understand how Brandis failed to identify the type collection of *S. gibbosa* with those of *H. grisea* as they are strikingly alike although the flowers of the latter are in the stage of young bud only whereas those of the former are almost fully developed. In examining the flowers of *H. grisea*, Brandis evidently noticed no gibbosities on the inner row of stamens. I have examined numerous flowers of *S. gibbosa* in various stages and find that the gibbosities are not evident in young buds.

Ridley amplified Brandis' original description in the works cited above and Foxworthy has reproduced Ridley's description. This description is adequate but Ridley has, I think, misinterpreted Brandis' statement with regard to the number of stamens. Brandis says "The filaments of the 5 inner stamens gibbous on the outside. Below this protuberance are inserted the 5 episepalous stamens of the outer circle." He does not state that the stamens are 10 only as Ridley and Foxworthy have inferred, and, as he has placed the species in the Section *Pinanga* presumably he recognised it to have 15 stamens. This actually is the case, the inner gibbous stamen being supported on the outside by two slightly smaller ones with overlapping filament bases. The gibbosity is not a solid structure but is in the nature of a hollow protuberance. There is also some discrepancy over the colour of the flowers. These I have never seen in fresh condition. Ridley originally stated that they were "pink" but later in his flora, pronounced them to be "creamy white."

Collections examined—

SINGAPORE: Ridley 6079 (Type of *S. gibbosa*, Brandis) S'pore 3407 and 5963.

BORNEO: Beccari 2232 and 2267 (Types of *H. grisea*, Brandis).

With this reduction we now have to record from Borneo this apparently rare species hitherto known only from a single tree which stood near the Botanic Gardens, Singapore.

Shorea eximia (Miq.) Scheff., Nat. Tijdschr. Ned. Ind. xxxi (1870) 349; Burck, Ann. Jard. Bot. Buitenzorg 6 (1887) 218; King, Journ. Asiat. Soc. Beng. lxii, 2

(1893) 121: *Vatica ? eximia,* Miq., Fl. Ind. Bat. Suppl. (1860) 486: *Vatica ? sub-lacunosa,* Miq. l.c.: *Shorea sub-lacunosa,* Scheff. l.c. 350: *Dilleniaceum ? nervosa,* Wall. Cat. 6635: *Shorea sericea,* Dyer, Hook. f. Fl. Brit. Ind. I (1872) 306; King, l.c. 111; Brandis, Journ. Linn. Soc. xxxi (1895) 101; Foxworthy, Mal. For. Rec. 10 (1932) 230: *Shorea rigida,* Brandis, Hook. Ic. Pl. (1895) t. 2402 and Journ. Linn. Soc. xxxi (1895) 102. —**Plate XLIII.**

This species was first described in 1860 by Miquel under two different names *Vatica ? eximia* and *Vatica ? sub-lacunosa.* His types were sterile collections from Sumatra and Bangka respectively. In 1870 Scheffer transferred these both to *Shorea* and in 1887 Burck united them.

A flowering collection (Maingay 202, Malacca) was first described by Dyer in 1872 as *Shorea sericea.* In 1895 Brandis referred a Bornean collection of Beccari, No. 2603, to *S. sericea* and redescribed the species as *Shorea rigida* from a Singapore collection of Ridley, No. 6393. These last two species have recently been united by Foxworthy.

Brandis, (l.c. 98) has united *S. eximia,* Scheff. with *S. furfuracea,* Miq. (l.c. 488) and has been followed by Ridley in Fl. Mal. Penin. I (1922) 232 and Merrill in Enum. Phil. Fl. Pl. III (1923) 96. I cannot agree to this union. The type of *S. furfuracea,* Miq. is an unsatisfactory sterile collection of immature leaves but is clearly different from *S. eximia,* Scheff. as has been pointed out by Van Slooten (ex Merr. Univ. Calif. Publ. Bot. 15 (1929) 204).

King did not unite *S. sericea* with *S. eximia* but in amplifying Dyer's description of the former, he evidently noted the resemblance between the species because he states—"This resembles *S. lacunosa,* Scheff., but differs in not having persistent stipules." (Presumably he has written "*S. lacunosa*" in mistake for "*S. sub-lacunosa.*").

The reduction of *S. sericea,* Dyer to *S. eximia,* Scheff. has already been indicated by Heyne (Nutt. Plant. Ned. Ind. 2nd edit. (1927) 1116) although in the 1917 edition of his work, p. 298, he gave *S. eximia,* Scheff. as a synonym of *S. furfuracea,* Miq. following Brandis.

The most complete description of this species is given by Foxworthy under *S. sericea* and Brandis' figure of *S. rigida* is very helpful. My experience in the examination of a number of flowers suggests the following alterations to Foxworthy's description—*Petals* elliptic oblong, retuse at apex, in mature flowers three times as long as sepals, glabrous within and along a narrow strip along one side without. *Stamens* from 55 to 67 (in flowers examined) on long filiform filaments, the longest almost as long as

the petals. Rudimentary appendage usually present although difficult to find. *Ovary* glabrous on lower portion but continued into an elongated conic sericeous stylopodium. Stigma broad and distinctly 3-partite.

Collections examined—

PENANG:	Curtis 431; S'pore 3471 & 3760; C. F. 2564 & 28019.
PERAK:	King 10998.
SELANGOR:	C. F. 733, 2445, 7052, 7909, 9623, 9642, 11200, 13925, 15289, 21373, 23853, 23867, 24005, 24014, 24708 & 26384.
NEGRI SEMBILAN:	C. F. 639, 646, 662, 665, 1930, 1931 & 23757.
MALACCA:	Maingay 202 (Type of *S. sericea*, Dyer).
TRENGGANU:	C. F. 26697, 26722, 26930, 26934 & 26938.
PAHANG:	C. F. 1022, 1794, 4068, 4529, 5456, 5475, 5732, 10859, 15015, 26511, 27954 & 28321.
SINGAPORE:	Wall. Cat. 6635 & Ridley 6393 (Type of *S. rigida*, Brandis).
SUMATRA:	"Pelembang, prope Muara-doea" Teysmann. (Type of *V. eximia*, Miq.).
BANGKA:	"Prope Plangas" Teysmann (Type of *V. sublacunosa*, Miq.).

The reduction made above recognises *Shorea eximia* as the correct botanical name for our common *meranti kepong*, the more commonly applied names of *S. sericea* and *S. rigida* lapsing into synonymy. There are many instances of species being described from immature sterile specimens and at another time from mature fertile collections under a different name. It is often not until more material representative of various stages of development is available that the names can be united. Just as a seedling form of *meranti tembaga* was described as *Shorea meranti* and later was united with *Shorea leprosula* which represented the mature form, so *S. eximia*, the immature form of *meranti kepong* is here united with *S. sericea* which represents the mature form. The older name which is retained, happens in this instance to have been applied to the immature form, whereas in the former instance it was applied to the mature form.

Shorea Maxwelliana, King, Journ. Asiat. Soc. Beng. lxii, ii 1893) 114; Ridley. Fl. Mal. Penin. I (1922) 227; Foxworthy, Mal. For. Rec. 10 (1932) 194: *Shorea utilis,* King, l.c. 119; Foxworthy, l.c. 177: *Shorea barbata,* Brandis, Journ. Linn. Soc. xxxi (1895) 81; Foxworthy, Mal. For. Rec. 3 (1927) 68 with plate and Mal. For. Rec. 10 (1932) 178: *? Shorea falcifera,* Dyer MSS. ex Brandis, l.c. 86: *Shorea ciliata,* Ridl., Agri. Bull. S.S. and F.M.S. 4 (1905) 63, not of King: *Shorea alba,* Ridl. Journ. Roy. As. Soc. S. Br. 82 (1920) 171.— **Plate XLIV.**

This species was first described by King in 1893 under two different names. The first was *S. Maxwelliana* which was based on two collections of fragmentary flowers and immature fruit made in Perak. The second was *S. utilis* described from a collection made in Penang. From his description it appears that he examined fairly good flowering material but now only fragmentary flowers remain on the sheet. There is no good reason why this should not have been identified with the material described as *S. Maxwelliana* but the latter have rather larger leaves and longer wings on the fruit.

The flowers of this species were first adequately described by Brandis in 1895 when he founded his *S. barbata* on a collection of Goodenough from Batang Malaka.

In examining the type material of *S. falcifera,* Dyer from Borneo I was struck by certain resemblances which it bears to *S. Maxwelliana.* When flowers of this Bornean form are available a more definite statement of the relationship of these species will be possible.

I have examined the collection of Moorhouse referred to by Ridley in op. cit. 1905, as *S. ciliata.* This undoubtedly is the species under discussion and not *S. laevis,* Ridl. to which Foxworthy refers it.

Ridley's *S. alba,* described in 1920, from a collection made in Penang is identical with *S. Maxwelliana.* The reduction of *S. alba,* Ridl. to *S. utilis,* King has already been made by Foxworthy in M.F.R. 10, 177. In the same year Ridley cited a sterile collection of *S. Maxwelliana* (Curtis 426) in describing his *Balanocarpus ovalifolius.* This same collection was wrongly identified by Brandis as *Balanocarpus latifolius* in l.c. 112 and also by Foxworthy in l.c. 143.

That Ridley had no clear conception of *S. Maxwelliana* is evident from the fact that in his flora he cites a specimen of Haniff from Penang (No. 3729) which is actually a Hopea.

With the aid of numerous sheets of this species in our collections it seems desirable to amplify the rather unsatisfactory descriptions hitherto given.

Leaves coriaceous, sometimes slightly inequilateral or subfalcate, usually lanceolate or ovate-lanceolate but may be oblong lanceolate, acuminate or caudate-acuminate, the base cuneate or occasionally rounded; the upper surface glabrous shining, chocolate or yellowish brown when dry; the lower similar or distinctly lighter or covered by a minute close peltate fugaceous tomentum; main nerves 7–11 pairs, curved, spreading, depressed and inconspicuous above, slightly raised and more conspicuous beneath; tertiary nerves finely curved and inconspicuous; length usually about 7.5 cm. x 3 cm., but may be from 5–11 cm. long and 2–5.5 cm. broad. Petiole 1–1.5 cm. *Panicles* axillary and terminal, up to 10 cm. long, stellate puberulous or covered with a white mealy tomentum; lateral branches distant, less than 1 cm. long, minutely tomentose, 3–6 flowered. *Flowers* distichous, very shortly pedicelled, more or less globular in bud, 2 mm. long, when expanded 5 mm. across. *Sepals* ovate-orbicular, blunt, densely tomentose outside, glabrous inside. *Petals* white, broadly oblong, blunt, slightly contort, sericeous outside, sparsely so inside. *Stamens* (in flowers examined) 24–41; filaments slightly dilated at base up to twice as long as the oblong bi-fid anthers; anther cells densely bearded above, minutely bearded below; appendage to connective slightly dilated, densely ciliate, slightly longer than the anther. (In immature flowers the connective and appendage are relatively shorter and the hairs at the foot of the anther cells are sometimes inconspicuous). *Ovary* conical, sericeous tomentose; style glabrous, usually short; stigma minute. *Ripe fruit* globose or ovoid, beaked, pale adpressed-sericeous, 1 cm. long; beak .5 cm. long, accrescent sepal wings closely adpressed to but free from the fruit, membranous, reticulate, deciduously puberulous, variable in size; the three outer similar, 7-nerved, broadly spathulate, slightly constricted at base from 3 x 1 cm. to 6.5 x 1.5 cm.; the two inner, 3–4 nerved, less than half as long, more or less linear.

Collections examined—

PENANG: Curtis 423 (Type of *S. utilis*, King) and 3651 (Type of *S. alba*, Ridl.); S'pore 3332, 3454, 3468, 3477, 3495, 3724 & 3733; C. F. 2568, 11671, 11677, 11680, 16637, 27774, 28030 & 28045.

PERAK:	King 3601 & 3744 (Types of *S. Maxwelliana,* King); C. F. 11736, 11966, 16054, 24480, 24503, 24640, 24645, 25413, 25423, 25429, 25487, 25821 & 25862.
DINDINGS:	C. F. 16560, 16577, 16597, 16651, 27764 & 27847.
SELANGOR:	C. F. 732, 24046, 24056 & 28053.
NEGRI SEMBILAN:	C. F. 5/1912, 401, 630, 653, 664, 721, 1901, 1934, 1982, 2145, 4314, 12821, 12822 & 23698.
MALACCA:	Ridley 1784 & 1789 (Types of *S. barbata,* Brandis); C. F. 2004, 4366 & 18272.
TRENGGANU:	C. F. 26903 & 26923.
PAHANG:	C. F. 4613, 4620, 4772, 4779, 5428, 5429, 5483, 5500, 5743, 6608, 6633, 10551, 10560, 10562, 10563, 15713, 15759, 15767, 26020 & 26036.
BORNEO:	? Beccari 2992 & 3046 (Types of *S. falcifera,* Dyer); ? Motley 37.

The failure to identify *S. Maxwelliana,* King with its synonyms given above has led to a regrettable vagueness in our conception of the botanical status of one of our most important hardwood trees. This tree is known usually as *damar laut daun kechil* in Penang, *damar laut kuning* in Kinta, *chengal batu* in the Dindings, *resak* in Selangor and Pahang, *kumus hitam* in Negri Sembilan and *tengkawang* in Trengganu but other names have also been applied (vide Foxworthy, Mal. For. Rec. 10 p. 177 and 179).

Shorea Faguetiana, Heim, Bull. Soc. Linn. Paris, ii (1891) 975; Brandis, Journ. Linn. Soc. xxxi (1895) 95: *Shorea dryobalanoides,* Dyer, MSS. in Herb. Kew: *Shorea Ridleyana,* King, Journ. Asiat. Soc. Beng. lxii, 2 (1893) 115 and Ann. Bot. Gard. Calc. V ii (1896) pl. 185B, in part; Brandis, l.c. 99; Foxworthy, Mal. For. Rec. 10 (1932) 209 in part.—**Plate XLV.**

This species was first described from Bornean collections of Beccari in 1891. In 1893 King described his *S. Ridleyana* citing two collections from Perak belonging to different species. No. 3617 upon which his description appears mainly to be based is *S. Faguetiana,* while 3571 is *Shorea hopeifolia* (Heim) Symington. King's figure in

Ann. Bot. Gard. Calc. represents for the most part the former species but the detail of leaf venation is typical of the latter.

Brandis in l.c. says of the flowers of *S. Ridleyana*—"Appendage to connective denticulate towards the apex." I have failed to see any sign of denticulation in any of the flowers examined. Foxworthy has reproduced the descriptions of King and Brandis without amplification and has considered together our collections of this species and of *S. hopeifolia* under the name of *S. Ridleyana*.

King and Ridley have suggested a close relationship between *S. Ridleyana* and *S. Maxwelliana* but it appears to me that the relationship is very remote. The species most closely allied to *S. Faguetiana* are, in my opinion, *S. hopeifolia* (Heim) Symington and *Balanocarpus multiflorus* (Burck) Symington notwithstanding the fact that the last must be kept apart under the present generic conception.

I am uniting *S. Faguetiana* and *S. Ridleyana* only after careful examination of collections both from Borneo and the Peninsula. Most of the Bornean collections have rather larger leaves than our collections but there is overlapping in this respect. The only fruits I have seen from Borneo are on Beccari 2954 and 2960. In form and texture these are identical with the fruit of our tree but the calyx wings are slightly longer.

The description by King of *S. Ridleyana* together with the drawing accompanying these notes should be adequate definition of this species.

Collections examined—

SIAM:	S'pore 24219, 24222, 24224 and 24339.
KEDAH:	C.F. 8907, 12225, 21924 and 27402.
PERAK:	King 3617 (Type of *S. Ridleyana*, King); C.F. 11591, 12067, 24512, 25439 and 25711.
SELANGOR:	C.F. 18226, 18247, 23094, 23211, 24386, 24394, 24397, 24398, 24450 and 24706.
NEGRI SEMBILAN:	C.F. 23348 and 23681.
PAHANG:	C.F. 1275, 3945, 3949, 5510, 6620, 6651, 8877, 9505, 10576, 10713, 10714, 10715, 10731, 12836, 15752, 23167, 23370 and 29305.

BORNEO: Becc. 2566, 2954, 2960 and 3039 (Types of *S. Faguetiana*, Heim). C.F. 12992, 28652, 28656, 28693 and 28705 (Brunei). ? Baram 241 and 307.

(*Note.*—It is possible that Baram 241 and 307 may belong to this species. The flowers are identical in every way with those of *S. Faguetiana* except for the petals which are much longer than any I have seen in our collections).

This is the tree which is usually called *damar siput*. Herbarium collections show considerable variation resulting in the tree having been described under two different names. These are here united and the older name of *S. Faguetiana* is retained.

Shorea hopeifolia (Heim) Symington, new comb.: *Cotylelobium ? hopeifolium*, Heim, Bull. Soc. Linn. Paris, i (1891) 971: *Shorea Ridleyana*, King, Journ. Asiat. Soc. Bengal, lxii, pt. 2 (1893) 115, in part; Foxworthy, Mal. For. Rec. 10 (1932) 209, in part: *Hopea Heimiana*, Brandis, Journ. Linn. Soc. xxxi (1894) 63: *Hopea albescens*, Ridley, Journ. Str. Br. R. As. Soc. 73 (1916) 142; not of Foxworthy, l.c. 122.—**Plate XLVI.**

Heim first described this species in 1891 from a fragmentary flowering collection of Beccari, No. 2491, referring it with hesitation to the genus *Cotylelobium* and giving it the inappropriate specific epithet "*hopeifolium.*" Two years later Brandis examined the same collection and transferred the plant to *Hopea*, renaming it *Hopea Heimiana*. In his description Brandis complains of the fragmentary nature of his material and gives rather an unsatisfactory account of the flower structure. In examining the same collection I was fortunate in finding one almost perfect flower which has enabled me without doubt to establish the identity of the plant with Ridley's *Hopea albescens*. In 1893 King described his *Shorea Ridleyana* from two sheets, Nos. 3617 and 3571. The former, upon which his description appears mainly to be based, is *S. Faguetiana*, Heim. to which I have reduced King's species, but No. 3571 is identical with *S. hopeifolia* (Heim) Symington. These species are so very closely related that it is not surprising that confusion should have occurred.

Foxworthy has followed King in including our collections of this species together with those of *S. Faguetiana*

under *S. Ridleyana*. To *Hopea albescens*, Ridl. he has referred a number of our collections which will probably turn out to be *Hopea fagifolia*, Miq.

Fruiting collections of this species have enabled me definitely to refer the plant to the genus *Shorea*. Unfortunately I must resurrect the specific epithet of Heim which is inappropriate and misleading.

Previous descriptions of this tree being hardly adequate I have prepared the following—

A medium to large tree; young branchlets slender, dark, lenticellate, minutely ridged and glabrous. *Leaves* thinly coriaceous glabrous, broadly ovate or oblong-lanceolate, bluntly acuminate at the apex, base rounded or cuneate sometimes with two glands at the insertion of the petiole; margin slightly inrolled; when dry usually purplish brown above, lighter beneath with purple veins; 4.5–9 cm. long, 2–5 cm. broad; petiole a little over 1 cm., rugose; secondary nerves 8–12 prs. spreading, inarching towards the margin, conspicuous beneath; between the secondary nerves 2 or 3 tertiary nerves leave the midrib parallel to the secondaries; tertiary reticulations usually distinct beneath. *Panicles* axillary and terminal, up to 7 cm. long, densely sericeous or fulvous pubescent, lax, branches each with 4–6 flowers, distichous and regularly alternating; flower bracts fugaceous, oblong, obtuse cymbiform, sericeous pubescent without. *Flowers* secund, 6 mm. long including the pedicel; pedicel 2 mm. *Sepals* sub-equal, rotundate, retuse (sometimes mucronate) at the apex, tomentose outside, glabrous within. *Petals* oblong, fimbriate obtuse at apex, 3 mm. long, pale yellow, sparsely puberulous outside. *Stamens* 15, sub-equal; filaments dilated in the lower half, arranged in 3's (2 long and 1 short) opposite each petal; anthers shorter than the filaments; awn filiform about the same length as the anther. *Ovary* conical, tomentose; stylopodium present but not obvious; style short, cylindric, glabrous; stigma minute. Fruit (immature) ovoid, pale tomentose, 5 mm. long, enclosed by but free from the accrescent calyx cup which is distinctly 5-angled, flattened at the base and sparsely stellate puberulous; wings papyraceous, puberulous with 7 longitudinal veins; 3 large wings sub-equal 5 cm. long, 1 cm. broad; 2 small wings 3 cm. long and 6 mm. broad.

To avoid further confusion of these very closely allied species, the main diagnostic characters of *S. hopeifolia* and *S. Faguetiana* are here enumerated. Along with these the characters of *Balanocarpus multiflorus* (Burck) Symington (= *B. penangianus*, King) are also considered, because although this species is quite distinct when in fruit, in

flower, vegetative characters and in the field it comes very close indeed. So remarkably similar are these three species that one cannot but doubt the sagacity of considering the nature of the fruiting calyx as a reliable index to the natural group to which they belong.

	Shorea hopeifolia	Shorea Faguetiana	Balanocarpus multiflorus
Leaves	Usually oblong-lanceolate or broadly ovate, purplish-brown above, greenish-brown or purple beneath with conspicuous purple veins. Secondary nerves 8-12 prs.; two or three tertiary nerves leave the midrib between each of the secondary nerves and parallel to them.	Ovate-lanceolate, usually larger than those of the other two species, when dry usually pale green or yellow above and lighter beneath Secondary nerves 8-12 prs.; tertiary nerves not as in *S. hopeifolia*	Usually oblong lanceolate, pale viridian above and golden yellow beneath. Secondary nerves 7-10 prs.; tertiary nerves not as in *S. hopeifolia*
Flower pedicel	2 mm. long	1 mm. long	Less than 1 mm. long
Sepals	Rotundate, retuse, sometimes mucronate	Obovate, acute	Triangular, obtuse & sometimes mucronate
Petals	A little more than twice as long as sepals	As in *S. hopeifolia*	About six times as long as sepals
Appendage to connective	As long as anther	Between 1 & 2 times as long as anther	As long as anther
Ovary	Densely tomentose	Minutely puberulous	Minutely puberulous
Fruit	Segments of fruiting calyx all enlarged into wings	As in *S. hopeifolia*	Segments of fruiting calyx forming a toothed cup shorter than the fruit.

Collections examined—

PERAK: King 3571 (cited as *S. Ridleyana* by King).

NEGRI SEMBILAN: C.F. 648.

PAHANG: " D^2 and D^3 ", De Sylva (Types of *H. albescens*, Ridl.); C.F. 0704, 5158, 5444, 6618, 7931, 8112, 8353, 13784, 15702, 23251 and 26037.

JOHORE: C.F. 5851.

BORNEO: Beccari 2491 (Type of *C. hopeifolium*, Heim and *H. Heimiana*, Brandis).

As yet we know but little of this tree in the jungle. Most of our collections are from the east of the Main Range in Pahang but it has also been collected in Tebong Reserve in Negri Sembilan and near Kluang in Johore. It has been collected under the names of *seraya, seraya batu, seraya labu, damar hitam* and *damar siput jantan.* The indications are that it closely resembles *Shorea Faguetiana* (damar siput) and *Balanocarpus multiflorus* (damar hitam) in the field as well as in the herbarium.

Balanocarpus multiflorus (Burck) Symington, new comb.: *Doona multiflora,* Burck, Ann. Jard. Bot. Bog. VI (1887) 234: *Richetia latifolia,* Heim, Bull. Soc. Linn. Paris, ii (1891) 976: *Richetia oblongifolia,* Heim l.c., 979: *Richetia acuminata,* Heim, l.c. 979: *Richetia penangiana,* Heim, l.c. 980: *Balanocarpus penangianus,* King, Journ. Asiat. Soc. Bengal, lxii, pt. 2 (1893) 131 and Ann. Bot. Gard. Calcutta, V. 2 (1896) 158, Pl. 191B.; Foxworthy, Mal. For. Rec. 3 (1927) 58, with 2 plates, and Mal. For. Rec. 10 (1932) 143: *Hopea multiflora,* Brandis, Journ. Linn. Soc. xxxi (1895) 60; not of Foxworthy, Mal. For. Rec. 10 (1932) 119: *Balanocarpus latifolius,* Brandis, l.c. 112; Foxworthy l.c. 145: *Balanocarpus acuminatus,* Brandis, l.c. 113.— **Plate XLVII.**

This species was first described as *Doona multiflora* by Burck in 1887 from a flowering collection made in Sumatra. In 1895 Brandis identified with this a collection bearing flowers made by Curtis in Penang and transferred the species to *Hopea.* Meanwhile Heim had described *Richetia latifolia, R. oblongifolia* and *R. acuminata* from fruiting collections made by Beccari in Borneo and *R. penangiana* from a collection of Curtis from Penang. These four collections are undoubtedly all of the same species but are representative of the variation found in leaf size and shape. Heim's species did not long remain in the genus to which he referred them. In 1893 King referred *Richetia penangiana* (Heim's type of the genus) to the older genus *Balanocarpus,* and in 1895 Brandis transferred *R. latifolia* and *R. acuminata* to the same genus and reduced *R. oblongifolia* to synonymy with *Balanocarpus latifolius.*

In 1899 Boerlage, in Cat. Hort. Bog. p. 102, drew attention to the similarity between *H. multiflora,* Brandis and *B. penangianus,* King but the reduction was never made.

Foxworthy's conception of *Balanocarpus penangianus* is quite clear and the collections C.F. 8135 and 15756 have quite reasonably been referred by him to *B. latifolius,* but

they differ from the collections under *B. penangianus* only in inessential characters which do not constitute specific distinction. He is mistaken, however, in referring the collections cited under *Hopea multiflora* (Burck) Brandis to that species. These collections belong to two distinct species one of which is probably *Hopea fagifolia*, Miq. and the other appears to be most closely related to *Hopea plagata*, Vidal.

This species has been adequately botanically described and figured by King under *Balanocarpus penangianus* but with the supply of material now available it is possible to make the following amplification—

The leaves may have as many as 10 pairs of nerves which are raised and often very conspicuous on the lower surface. The fine reticulations of the leaf may be inconspicuous or clearly defined and of a pellucid nature. It is very characteristic of the species that the leaves usually dry to a pale viridian colour above and a light golden-brown beneath. Some leaves may be over 5 cm. broad. Although 15 is the usual number of stamens, occasionally only 10 are present. Occasionally there are distinct indications of a stylopodium. The fruit may be considerably more swollen in the upper portion than King has figured it and may be as much as 2 cm. long and 1.2 cm. broad.

Collections examined—

PENANG:	Curtis 429 (type of *R. penangiana*, Heim) and 3605; S'pore 3145, 3264, 3293, 3403, 3469, 3492, 3714, 3748 and 4650; C.F. 1844, 2470, 2562, 10846 and 11656.
KEDAH:	C.F. 8905 and 27470.
PERAK:	King 3333; C.F. 0114, 4571, 8843, 25428, 25449, 25508, 28982 and 28983.
DINDINGS:	C.F. 16584 and 27850.
SELANGOR:	C.F. 5204, 9971, 10819, 12954, 14830, 14831, 22057, 22073 and 22832.
NEGRI SEMBILAN:	C.F. 1790, 2006, 2125, 6552 and 12823.
MALACCA:	C.F. 2064.
TRENGGANU:	C.F. 26707 and 26744.
PAHANG:	C.F. 8135, 15756, 15770 and 26175.

SUMATRA: "Ex. Herb. Bog. Recd. Kew 3/1888" (? type of *D. multiflora*, Burck).

BORNEO: Beccari 2511 (type of *R. oblongifolia*, Heim), 2892 (type of *R. latifolia*, Heim) and 2942 (type of *R. acuminata*, Heim); C.F. 28703 (Brunei).

This is the tree commonly known to Malayan Forest Officers as *damar hitam* under the specific name of *Balanocarpus penangianus*, King. With the reduction of King's species to synonymy with the species originally described by Burck as *Doona multiflora* the specific epithet of the former gives way to the older epithet and the new combination becomes *Balanocarpus multiflorus* (Burck) Symington.

INDEX.

Names of species especially dealt with in this paper are shown in heavy type and synonyms are printed in italics.

PAGE.

Balanocarpus acuminatus, Brandis....153
Balanocarpus Hemsleyanus, King....129
Balanocarpus latifolius, Brandis....153
Balanocarpus multiflorus (Burck) Symington....153, Pl. 47
Balanocarpus ovalifolius, Ridl....146
Balanocarpus penangianus, King....153
Cotylelobium hopeifolium, Heim....150
Dilleniaceum nervosa, Wall....144
Doona multiflora, Burck....153
Hopea albescens, Ridl....150
Hopea fagifolia, Miq....154
Hopea grisea, Brandis....143
Hopea Heimiana, Brandis....150
Hopea multiflora, Brandis....153
Hopea plagata, Vidal....154
Pachychlamys Beccarianus, Dyer....141
Pachychlamys Hemsleyanus, Ridl....129
Richetia acuminata, Heim....153
Richetia latifolia, Heim....153
Richetia oblongifolia, Heim....153
Richetia penangiana, Heim....153
Shorea alba, Ridl....146
Shorea aptera, Burck....136, 141
Shorea barbata, Brandis....146
Shorea brachyptera, Heim....141
Shorea ciliata, Ridl....146
Shorea cochinchinensis, var *oligoneura*, Boerl....134
Shorea dryobalanoides, Dyer....148
Shorea eximia (Miq.) Scheff....143, Pl. 43
Shorea Faguetiana, Heim....148, Pl. 45
Shorea falcifera, Dyer....146
Shorea furfuracea, Miq....144
Shorea gibbosa, Brandis....143, Pl. 42
Shorea grandiflora, Brandis....129
Shorea Hemsleyana, King....129, Pl. 33
Shorea hopeifolia (Heim) Symington....150, Pl. 46
Shorea laevis, Ridl....146
Shorea lepidota (Korth.) Bl....135, Pl. 38
Shorea lepidota, Foxw....141
Shorea leprosula, Boerl....133
Shorea leprosula, Miq....133, 145
Shorea macrantha, Brandis....131, Pl. 34
Shorea Maxwelliana, King....146, Pl. 44

PAGE.

Shorea megistocarpa, Foxw.....135
Shorea meranti, Burck.....145
Shorea nigrescens, Dyer.....133
Shorea nitens, Miq.....135
Shorea ovata, Dyer.....140, Pl. 40
Shorea palembanica, Miq.....141, Pl. 41
Shorea paludosa, Foxw.....134
Shorea palustris, Ridl.....133
Shorea parvifolia, Dyer.....137, Pl. 39
Shorea parvifolia, King.....140
Shorea parvifolia, Foxw.....140
Shorea platycarpa, Heim.....133, Pl. 36
Shorea Ridleyana, King.....148, 150
Shorea rigida, Brandis.....144
Shorea rugosa, Heim.....132, Pl. 35
Shorea scutulata, Foxw.....138, 140
Shorea scutulata, King.....137
Shorea sericea, Dyer.....144
Shorea singkawang (Miq.) Burck.....142
Shorea stipulosa, Burck.....135
Shorea sub-lacunosa, Scheff.....144
Shorea Teysmanniana, Dyer.....134, Pl. 37
Shorea Thiseltoni, King.....142
Shorea uliginosa, Foxw.....132
Shorea utilis, King.....146
Shorea verrucosa, Dyer.....132
Vatica eximia, Miq.....144
Vatica lepidota, Korth.....135
Vatica stipulosa, Miq.....135
Vatica sub-lacunosa, Miq.....144

EXPLANATION OF PLATES.

PLATE XXXIII. **Shorea Hemsleyana**, King. 1, flowering twig. 2, panicle in bud. 3, ripe fruit. 4, ripe fruit (wings broken). 5, immature fruit. 6, open flower. 7, flower bud (bracts present). 8, 9, sepals. 10, 11, petals from bud. 12, stamens from young bud. 13, stamens from more mature bud. 14, stamens from mature flower. 15, ovary from bud. 16, ovary from mature flower. (*Scale applies to Nos. 1 to 5 only*).

PLATE XXXIV. **Shorea macrantha**, Brandis. 1, flowering twig. 2, mature fruit. 3, expanded flower. 4, flower bud. 5, large sepal (posterior). 6, small sepal (posterior). 7, stamens from flower bud. 8, stamens from mature flower. 9, ovary from bud. 10, ovary from mature flower. (*Scale applies to Nos. 1 and 2 only*).

PLATE XXXV. **Shorea rugosa**, Heim. 1, flowering twig. 2, mature fruit. 3, flower bud. 4. corolla from mature flower. 5, large sepal (posterior). 6, small sepal (posterior). 7, ovary and stamens. 8, petal from bud (posterior). 9, petals from bud (anterior). 10, stamens from mature flower. (*Scale applies to Nos. 1 and 2 only*).

PLATE XXXVI. **Shorea platycarpa**, Heim. 1, flowering twig. 2, mature fruit. 3, flower bud. 4, expanded flower. 5, petal from mature flower. 6, 7, petals from flower bud. 8, 9, sepals. 10, stamens from flower bud. 11, stamen showing gibbosity. 12, ovary. (*Scale applies to Nos. 1 and 2 only*).

PLATE XXXVII. **Shorea Teysmanniana**, Dyer. 1, mature twig. 2, twig from seedling. 3, fruit. 4, mature flower. 5, flower bud. 6, 7, sepals. 8, 9, petal from bud. 10, stamens from bud. 11, mature stamens. 12, ovary. (*Scale applies to Nos. 1 to 3 only*).

PLATE XXXVIII. **Shorea lepidota**, (Korth.) Bl. 1, flowering twig. 2, twig from seedling. 3, characteristic gall formation. 4, young panicle showing bracts. 5, very young fruit. 6, mature fruit. 7, floral bract. 8, flower bud. 9, 10, petal from bud. 11, petal from mature flower. 12, 13, sepals. 14, stamens from young bud. 15, stamens from more mature bud. 16, stamens from mature flower. 17, ovary. (*Scale applies to Nos. 1 to 6 only*).

PLATE XXXIX. **Shorea parvifolia**, Dyer. 1, flowering twig. 2, panicle. 3, shoot showing stipules of broad type. 4, shoot with stipules of linear type. 5, mature fruit. 6, floral bract. 7, flower bud. 8, mature flowers. 9, 10, sepals. 11, 12, petals. 13, stamens from bud. 14, stamens from mature flower. 15, ovary. (*Scale applies to Nos. 1 to 5 only*).

PLATE XL. **Shorea ovata**, Dyer. 1, flowering twig. 2, twig with short-winged mature fruit. 3, mature fruit, long winged. 4, mature flower. 5, flower bud. 6, petal from mature flower (posterior). 7, the same (anterior). 8, small sepal. 9, large sepal. 10, ovary from mature flower. (*Scale applies to Nos. 1 to 3 only*).

PLATE XLI. **Shorea palembanica**, Miq. 1, flowering twig. 2, branchlet from seedling. 3, 4, 5, 6, various stages in development of fruit (in 6 the wings are broken). 7, part of young inflorescence showing floral bracts. 8, mature flower. 9, flower bud. 10, 11, sepals. 12, 13, petals. 14, stamens from mature flower. 15, stamens from flower bud. 16, ovary. (*Scale applies to Nos. 1 to 7 only*).

PLATE XLII. **Shorea gibbosa**, Brandis. 1, flowering twig. 2, mature flower. 3, flower bud. 4, ovary. 5, petal. 6, 7, sepals. 8, stamens from bud. 9, 10, 11, 12, 13, stamens from mature flower. (*Scale applies to 1 only*).

PLATE XLIII. **Shorea eximia** (Miq.) Scheff. 1, flowering twig. 2, twig showing stipules. 3, characteristic gall. 4, mature fruit. 5, corolla from expanded flower. 6, flower bud. 7, large sepal (posterior). 8, small sepal (posterior). 9, petal (posterior). 10, petal (anterior). 11, bundle of stamens from bud. 12, anther showing minute appendage. 13, ovary. 14, stigma. (*Scale applies to Nos. 1 to 4 only*).

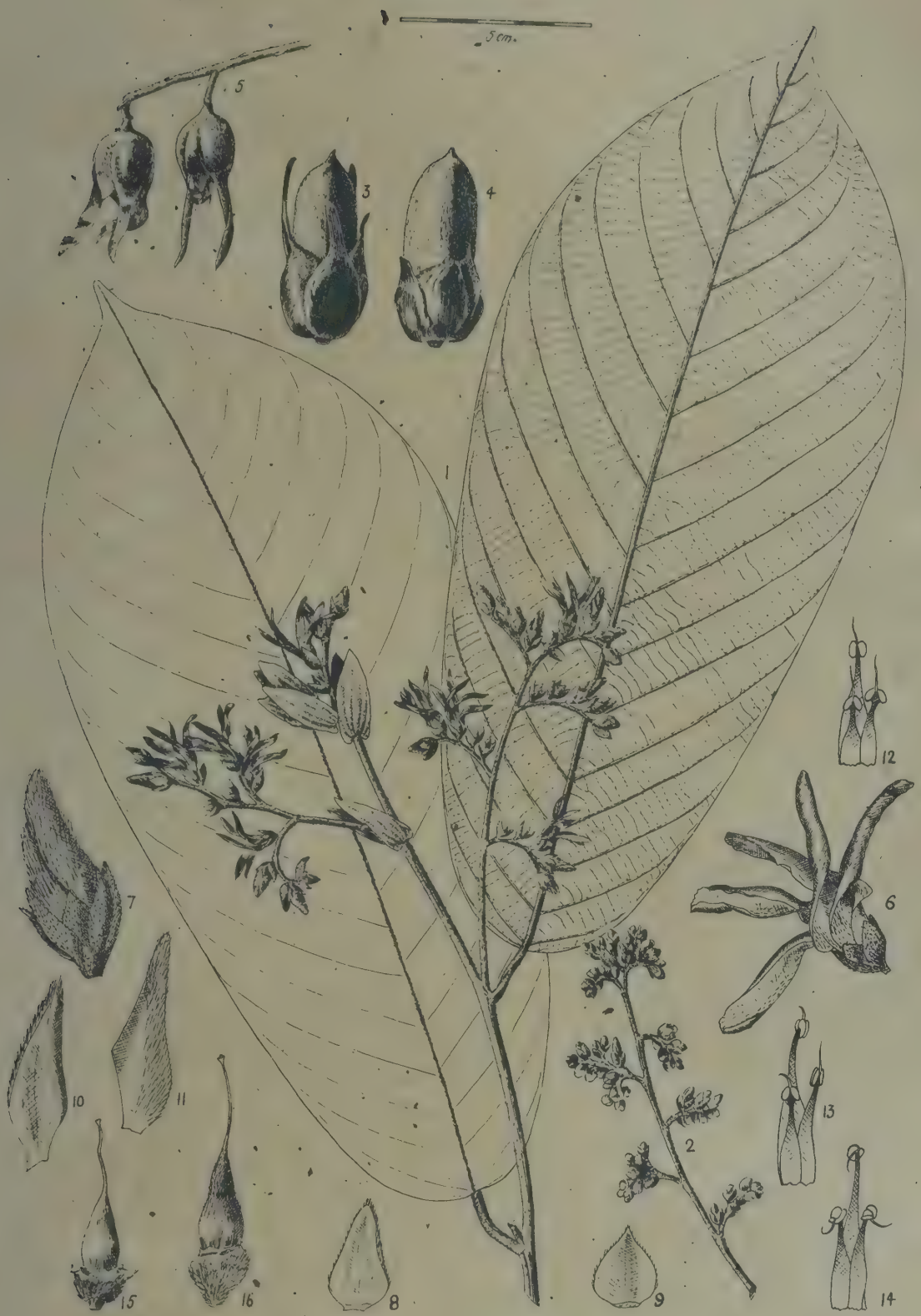
PLATE XLIV. **Shorea Maxwelliana**, King. 1, flowering twig. 2, 3, mature fruit. 4, expanded flower. 5, corolla from mature flower. 6, flower bud. 7, 8, sepals. 9, 10, ovary. 11, stamen from mature flower. 12, stamen from bud. 13, bundle of immature stamens. (*Scale applies to Nos. 1 to 3 only*).

PLATE XLV. **Shorea Faguetiana**, Heim. 1, flowering twig. 2, 3, 4, fruit in progressive stages. 5, flower. 6, ovary. 7, petal from mature flower. 8, 9, sepals. 10, 11, stamens from mature flower. (*Scale applies to Nos. 1 to 4 only*).

PLATE XLVI. **Shorea hopeifolia** (Heim) Symington. 1, flowering twig. 2, fruit, not yet mature. 3, the same, showing ovary. 4, twig with very young fruit. 5, flower. 6, ovary of mature flower. 7, 8, sepals. 9, petal from mature flower. 10, 11, stamens. (*Scale applies to Nos. 1, 2, and 4 only*).

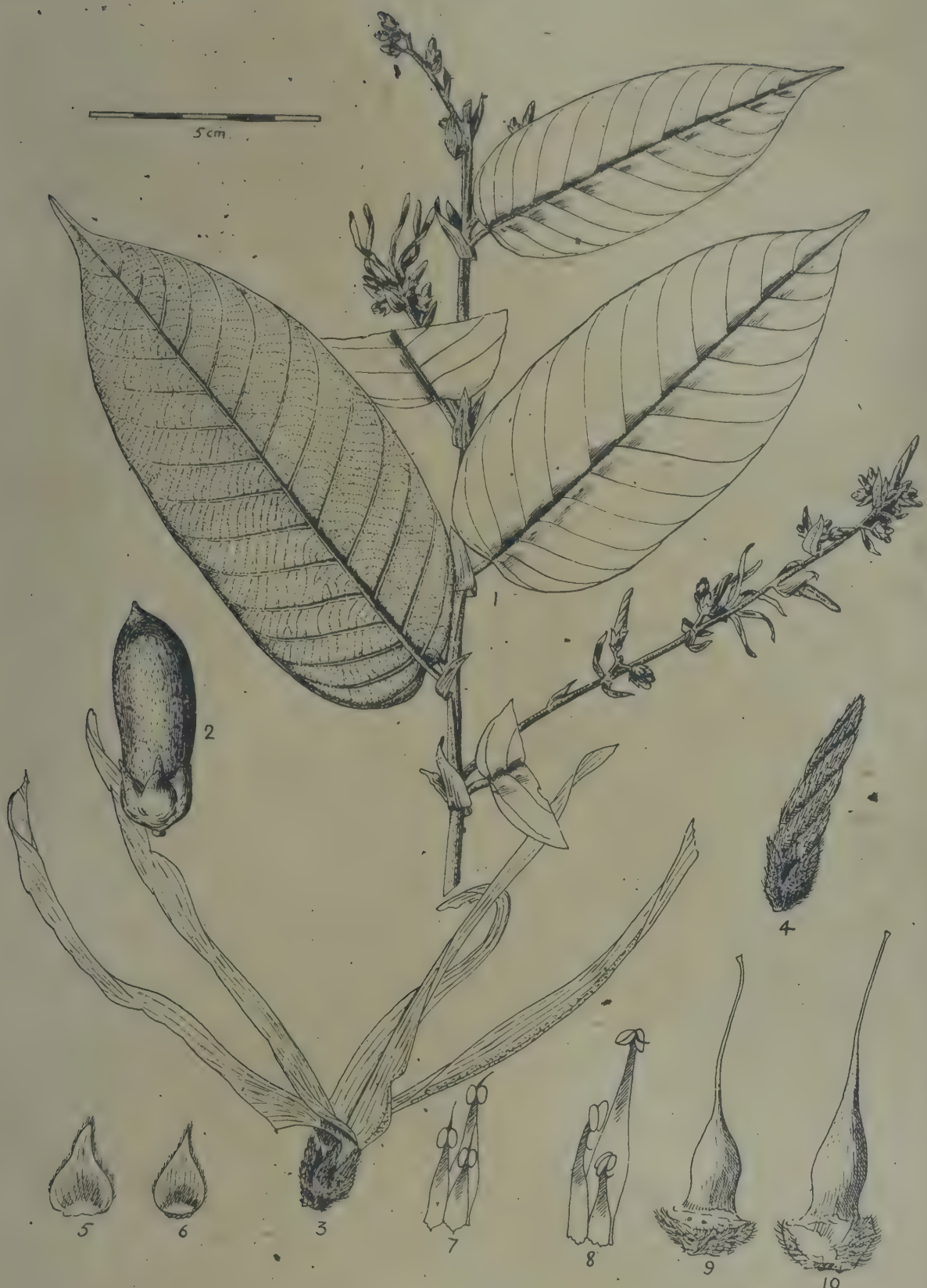
PLATE XLVII. **Balanocarpus multiflorus** (Burck) Symington. 1, flowering twig. 2, fully expanded panicle. 3, twig with immature fruit. 4, twig with mature fruit. 5, open flower. 6, flower bud. 7, ovary. 8, petal from mature flower. 9, 10, sepals. 11, 12, stamens. (*Scale applies to Nos. 1 to 4 only*).

Plate 33.



Gard. Bull. S.S. Vol. VII.

Plate 34.



Gard. Bull. S.S. Vol. VII.

Plate 35.

Gard. Bull. S.S. Vol. VII.

Plate 36.

Gard. Bull. S.S. Vol. VII.

Plate 37.

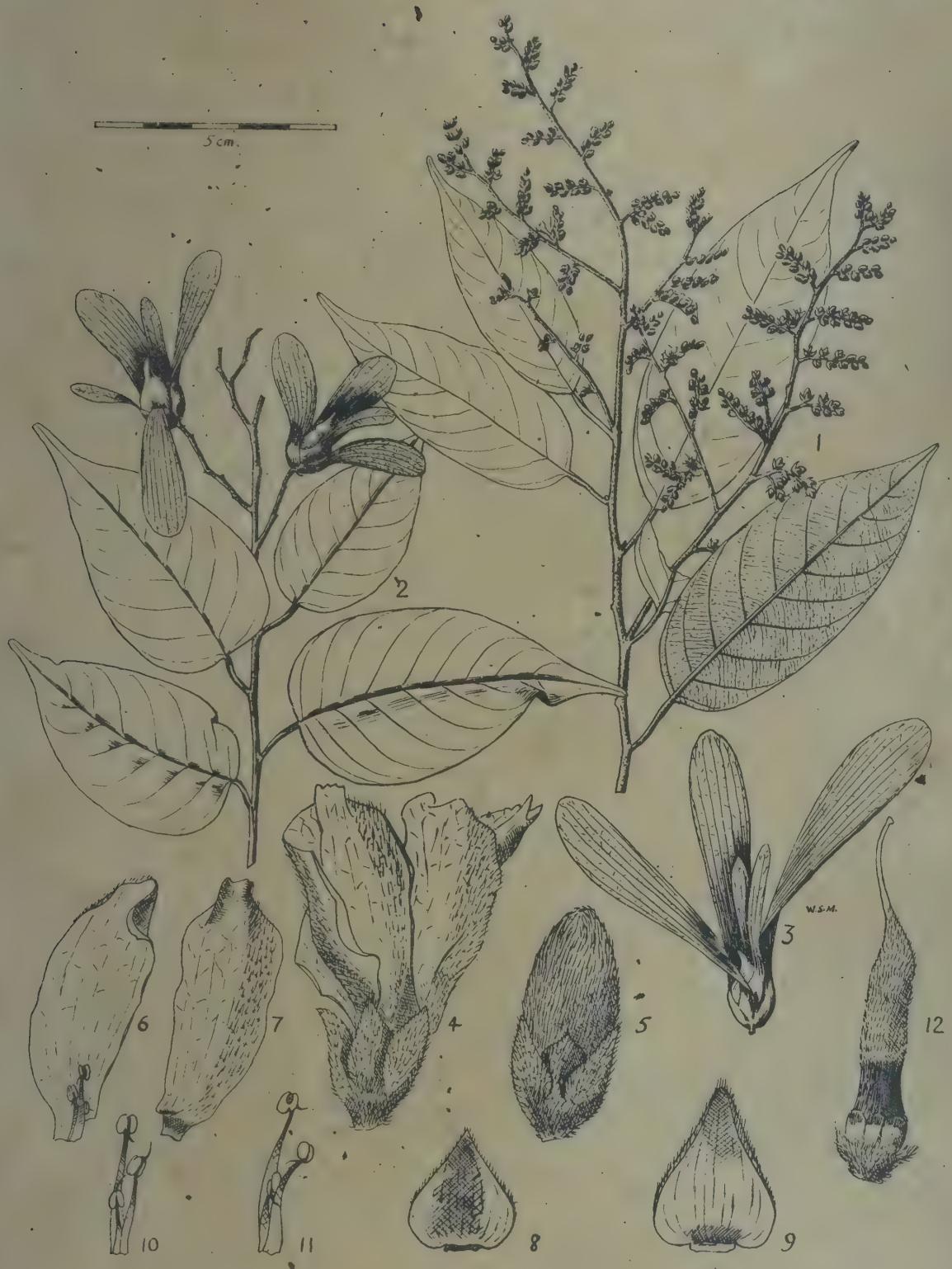
Gard. Bull. S.S. Vol. VII.

Plate 38.

Gard. Bull. S.S. Vol. VII.

Plate 39.

Plate 40.

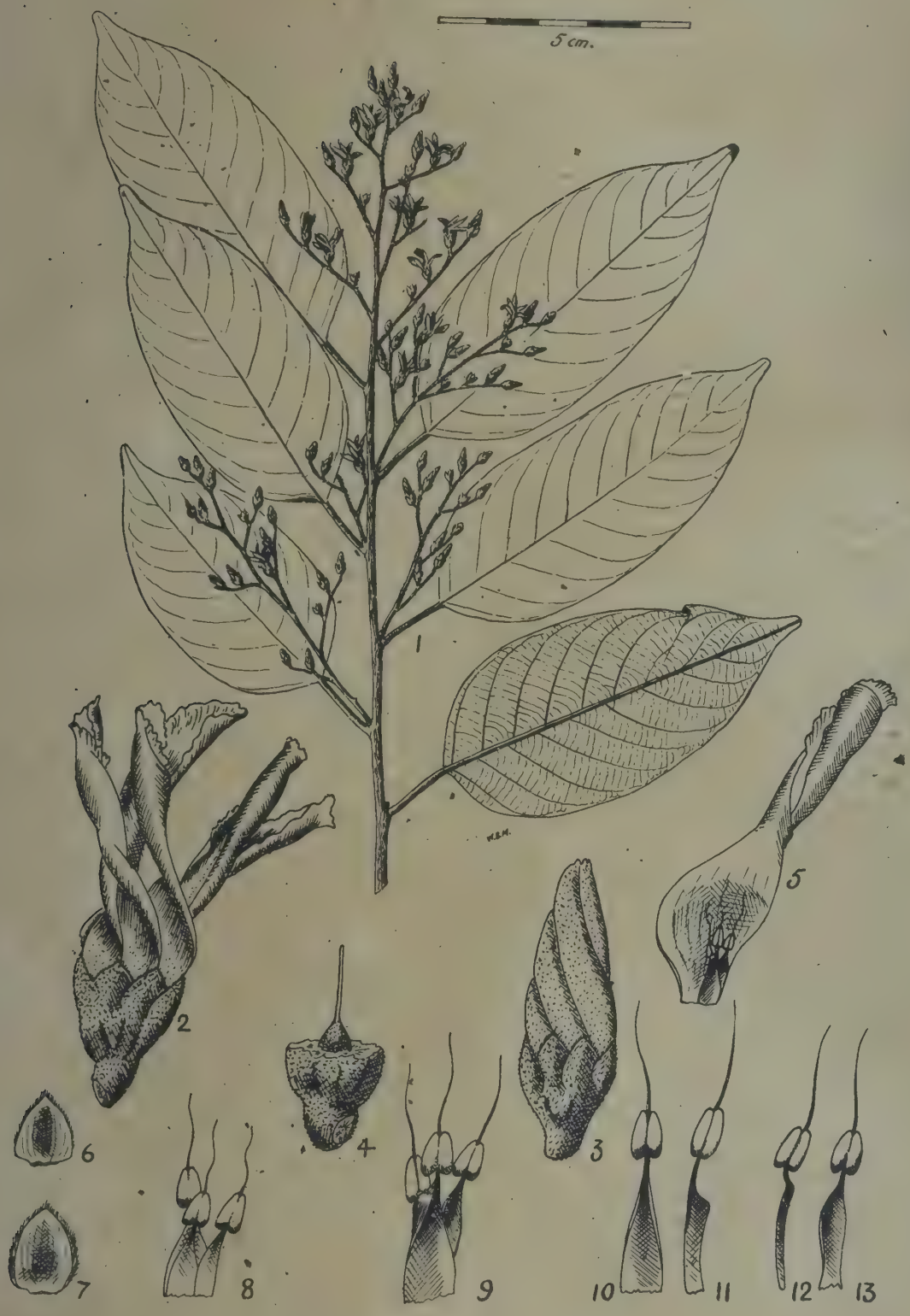


Gard. Bull. S.S. Vol. VII.

Plate 41.

Gard. Bull. S.S. Vol. VII.

Plate 42.



Gard. Bull. S.S. Vol. VII.

Plate 43.

Gard. Bull. S.S. Vol. VII.

Plate 44.

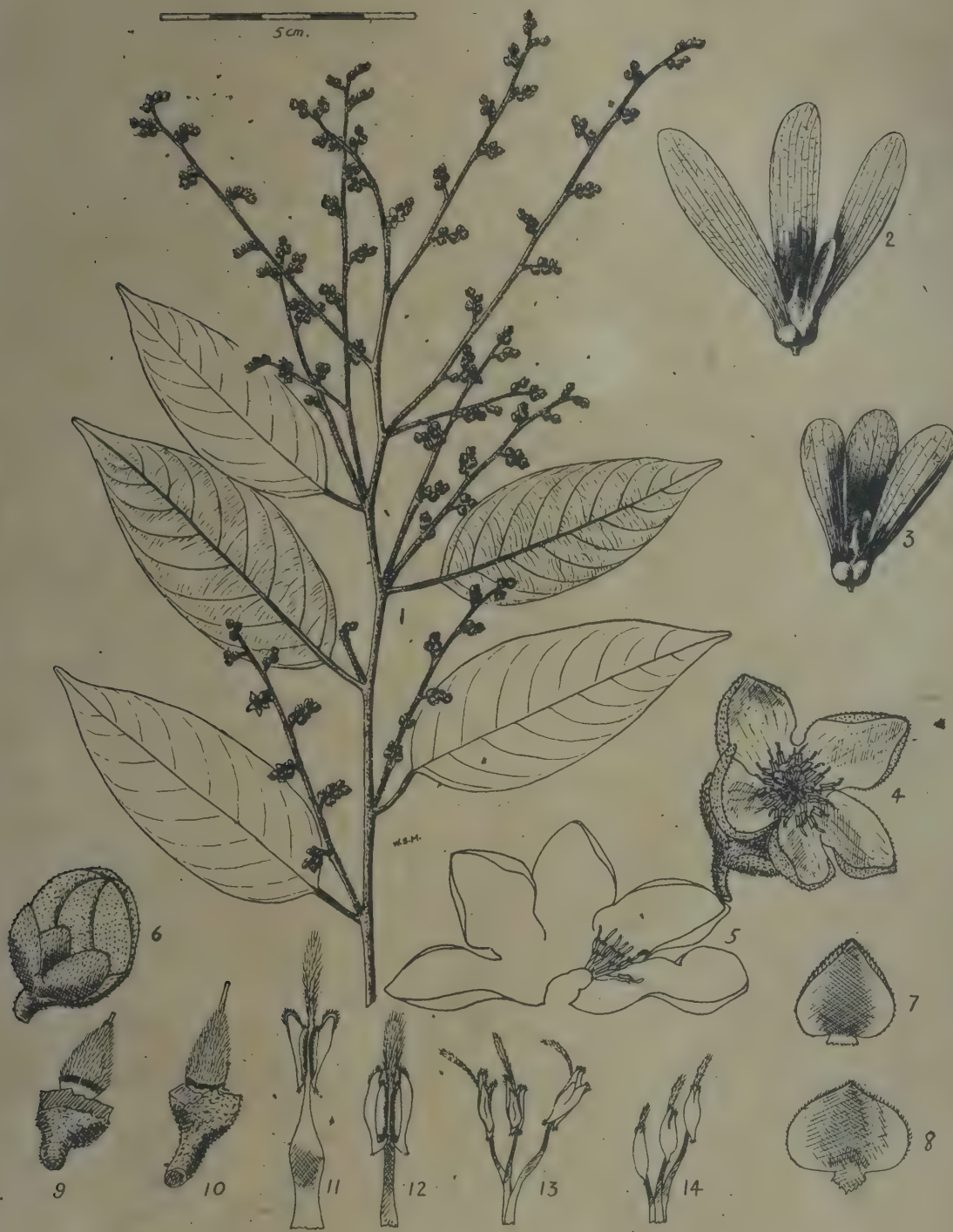
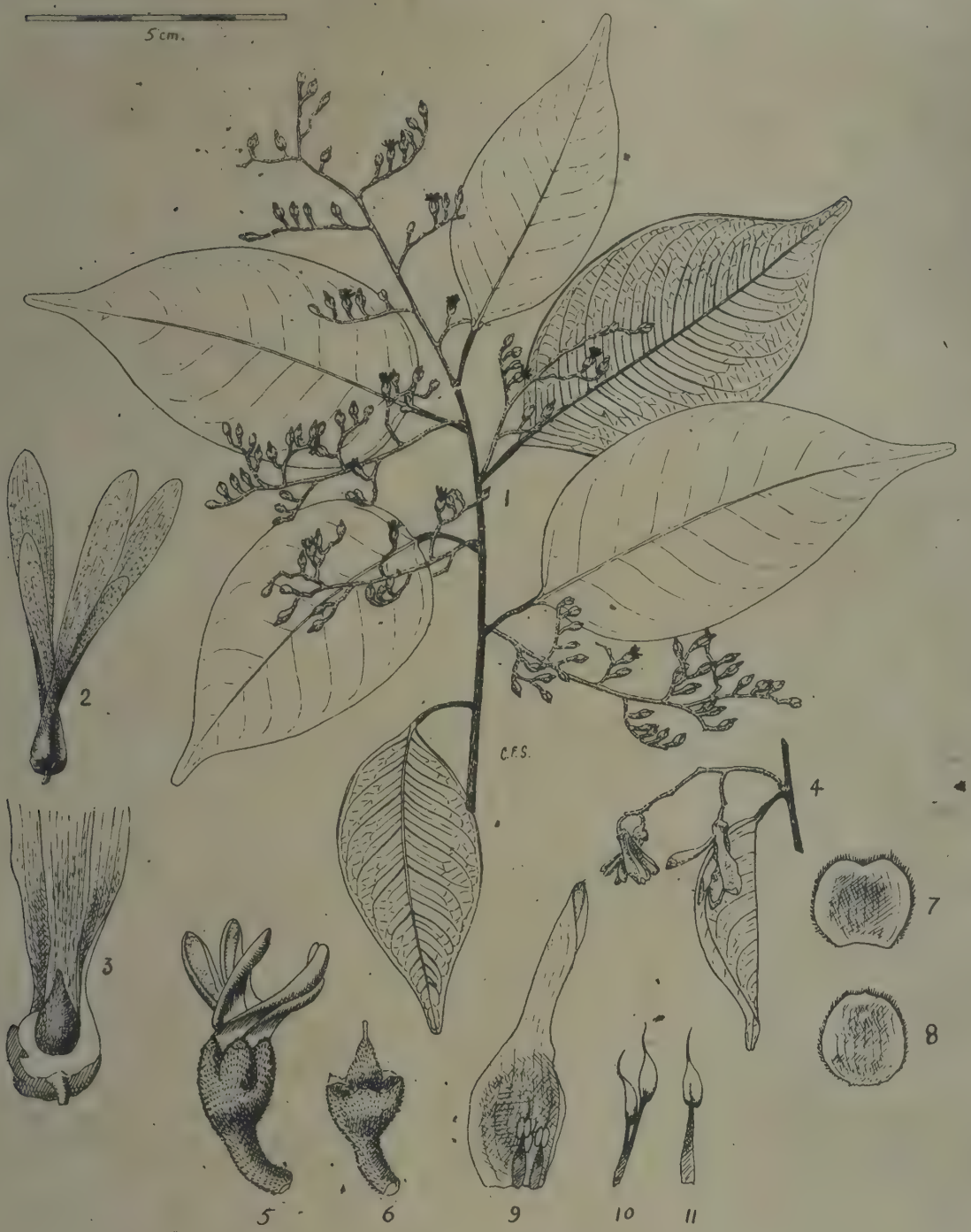


Plate 45.

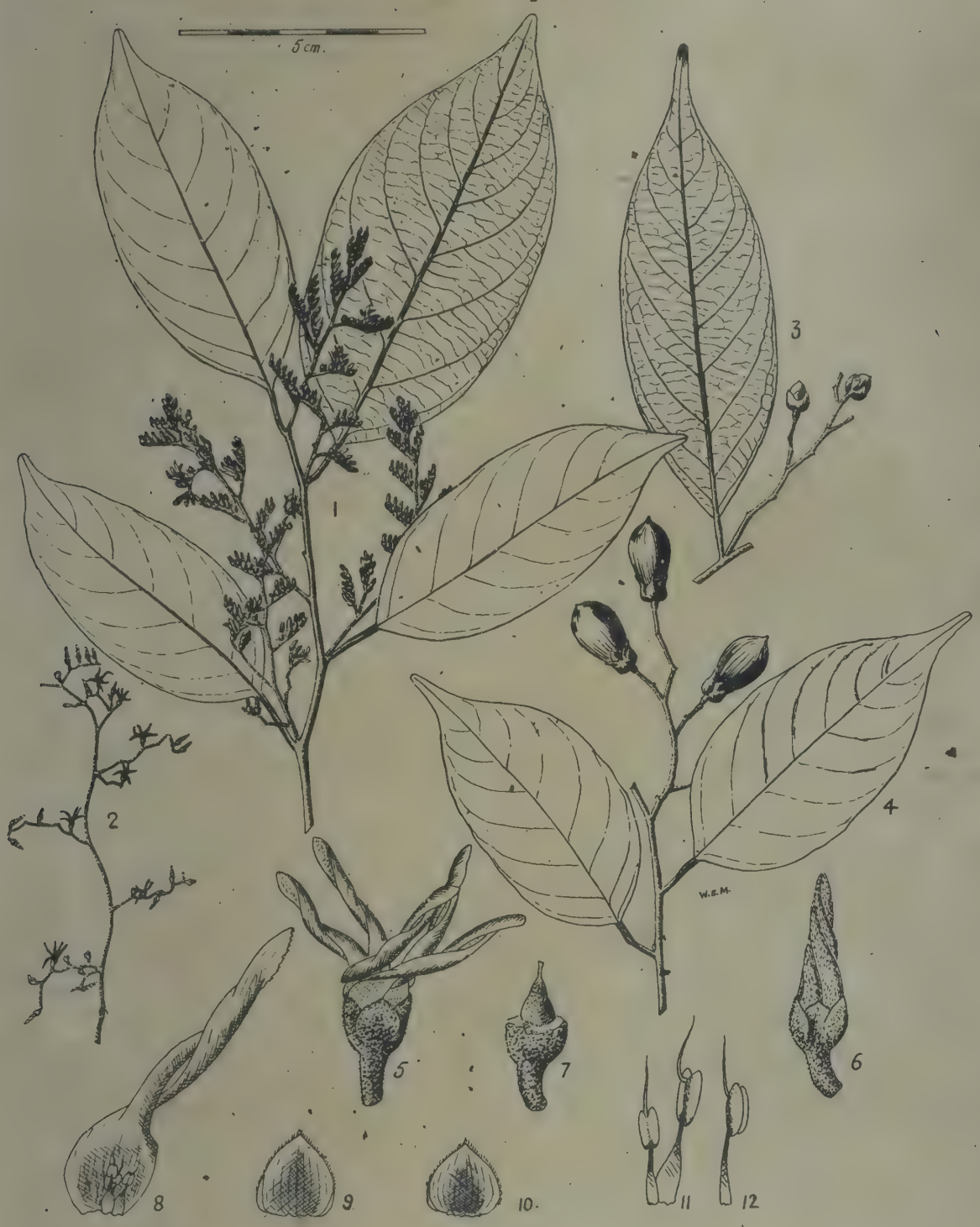
Gard. Bull. S,S. Vol. VII.

Plate 46.



Gard. Bull. S.S. Vol. VII.

Plate 47.



ENUMERATION OF MALAYAN EBENACEAE.

(With brief descriptions of new and noteworthy species).

By R. C. Bakhuizen van den Brink.

On account of economic circumstances it will take a considerable time before my studies on the Malayan Ebenaceae can be printed in full. It is evident that the elaboration of such a complicated family as the Ebenaceae necessitated the removal of a large number of old specific names and a considerable addition of new ones. Therefore, to avoid further confusion in the nomenclature of the family, it is necessary to give at least a superficial survey, as soon as possible, of the results obtained. The following contribution serves to enumerate the number of species which, in my opinion, occur within both the Malay Archipelago and Peninsula.

While studying the Ebenaceae of the Malay region I became fully convinced that no valid grounds can be found for keeping the genus *Maba* separate from *Diospyros*. Hiern in his excellent monograph did not succeed in laying down hard and fast boundaries between the two genera on natural principles. But, when that work was published in 1873, much less material of intermediate and transition forms was known than at the present time. Therefore I decided to unite the genera *Diospyros* (sensu stricto) and *Maba* into one: *Diospyros* sensu latiore, the more so as it is impossible to indicate any practical advantage in the separation. In order not to lose sight of the old genus *Maba*, I thought it advisable to give it the rank of a subdivision together with three other subgenera, into which I now divide the enlarged genus *Diospyros* L., as far as the Malayan regions are concerned.

Diospyros DALECH. ex LINN. (sensu latiore).

(Conspectus subgenerum).

A. Ovarium 3-6-loculare; loculis 1-2-ovulatis; ovulis in toto 6. Flores 3-meri, raro 4-5-meri. Calix aestivatione valvatus vel subvalvatus, interdum accrescens. Semiña albumine aequabile vel ruminato.—Utriusque orbis reg. calid. α subgen. **Maba** (J. R. et G. FORST.) BAKH.

B. Ovarium 2-3-loculare; loculis 2-ovulatis; ovulis in toto 4-6. Flores 4-5-meri. Calicis lobi suborbiculares vel reniformes, aestivatione contorte imbricati, non vel vix accrescentes. Semina albumine ruminato.—Asia reg. calid. β subgen. **Hierniodendron** BAKH.

C. Ovarium 4-loculare; loculis 2-ovulatis; ovulis in toto 8. Flores 4-meri. Calicis lobi triangulares, aestivatione valvati. Semina albumine aequabile.—Australia. γ subgen. **Cargillia** (R.BR.) BAKH.

D. Ovarium 4-5-, 8-10- vel 16-?20-loculare; loculis 1-ovulatis; ovulis in toto 4-5, 8-10 vel 16-?20. Flores 4-5-7-(?8-10)-meri. Calicis lobi valde variabiles vel rarius subnulli, aestivatione plerumque imbricati. Semina albumine aequabile vel ruminato.—Utriusque orbis reg. calid., Asia temp., America bor. δ subgen. **Eu-Diospyros** (L.) BAKH.

α Subgen. **Maba** (J. R. et G. FORST.) BAKH.

1. **Diospyros carpinifolia** (RIDL.) BAKH., comb. nov.—*Maba sumatrana* MIQ.; *Maba carpinifolia* RIDL.

2. **D. confertiflora** (HIERN) BAKH., comb. nov.—*Maba confertiflora* HIERN.

3. **D. ellipticifolia** (STOKES) BAKH., comb. nov.—*Maba elliptica* J. R. et G. FORST.; *Ferreola ellipticifolia* STOKES.

4. **D. fasciculosa** F. V. MUELL.—*Maba fasciculosa* F. V. MUELL.

5. **D. ferrea** (WILLD.) BAKH., comb. nov.—*Maba buxifolia* (ROTTB.) A. L. JUSS.; *Ehretia ferrea* WILLD.

6. **D. hermaphroditica** (ZOLL.) BAKH., comb. nov.—*Maba hermaphroditica* ZOLL.

7. **D. Holttumii** BAKH., spec. nov. **Plate XLVIII**—Frutex; ramulis glabris. Folia tenuiter coriacea, ovato-oblonga, basi obtuse cuneata, apice obtuse acuminata, utrinque glabra; nervis lateralibus utrinsecus 7-10, utrinque prominulis, venis utrinque inconspicuis; petiolo semitereti, glabro, 0.5—1 cm longo. Flores dioici;—feminei solitarii, subsessiles; calice profunde 3-4-lobato, intus glabro, lobis ovato-oblongis, acute acuminatis,

striatis. Fructus depresso-globosus, nitidus, glaber, 1—2 cm diam.; seminibus 6-8, albumine aequabile; calice lobis coriaceis, apice reflexis, 0.75—1 cm longis, 0.5—0.75 cm latis.—Kedah (HOLTTUM 15122).

8. **D. Janowskyi** BAKH., spec. nov.—*Maba Janowskyi* BAKH., msc.—Frutex. Folia lanceolata vel oblanceolata, dense verruculosa et pellucido-punctata, 7.5—17.5 cm longa, 2.5—5.5 cm lata, apice breviter subcaudato-obtuse acuminata; petiolo tereti, 0.15—0.3 cm longo. Cymae gracile pedunculatae, subpaniculatae, 3-5-florae. Flores masculi staminibus 9-12; feminei staminodiis 0; ovario pubescente, 6-loculare, loculis uniovulatis. Fructus oblongo-ellipsoideus vel subfusiformis, distincte verruculosus, pubescens vel maturitate glabrescens, 3—4.5 cm longus; seminibus albumine aequabile; calice 3-lobo, intus glabro, 0.35—0.5 cm diam.; lobis late ovatis obtusis.—Nova Guinea (JANOWSKY 109).

9. **D. malayana** BAKH., nom. nov.—*Maba punctata* (KORTH.) HIERN.

10. **D. rostrata** (MERR.) BAKH., comb. nov.—*Maba rostrata* MERR.

11. **D. tahanensis** BAKH., spec. nov.—*Maba tahanensis* BAKH., msc.—Arbor mediocris. Folia elliptico-oblonga vel lanceolata, basi obtusa vel rotundata, apice obtuse acuminata, verruculosa et dense pellucido-punctata, utrinque glaberrima, 10—22 cm longa, 2.5—6.5 cm lata; petiolo semitereti, 0.7—1 cm longo. Cymae subsessiles, multibracteatae. Fructus ovoideo-oblongus vel subellipsoideus, utrinque rotundatus, breviter apiculatus, verruculosus, primo tomentosus, maturitate glabrescens, 2—3 cm longus, 1.5—2 cm diam., 6-locularis, loculis monospermis; seminibus albumine aequabile; calice profunde 3-lobo, intus glabro, 0.5—1 cm diametro.—Pahang, Tahan River (RIDLEY—VIII. 1891).

β Subgen. **Hierniodendron** BAKH.

12. **D. evena** BAKH., spec. nov.—Arbor mediocris. Folia firmiter coriacea, elliptica vel oblanceolata, basi

angustata, obtusa, apice rotundata, emarginata, adulta utrinque glabra, 2—9 cm longa, 1—3 cm lata, venis inconspicuis; petiolo semitereti. Flores feminei solitarii, breviter pedunculati; pedunculo tomentoso, 0.15—0.2 cm longo; calice intus glabro. Fructus ellipsoideus, primo pubescens, denique glabratus, 2—3 cm longus.—Borneo (HAVILAND and HOSE 3348; Boschpr. bb. 7264, 7789, 12643).

13. **D. Maingayi** (HIERN) BAKH., comb. nov.—*Maba Maingayi* HIERN.

14. **D. puncticulosa** BAKH., nom. nov.—*Maba Beccari* HIERN.

γ Subgen. **Cargillia** (R.BR.) BAKH.

Only known from Australia.

δ Subgen. **Eu-Diospyros** (L.) BAKH.

15. **D. adenophora** BAKH., spec. nov.—Arbor parva; ramulis glabris. Folia coriacea, elliptico-oblonga, basi obtusa vel rotundata, apice breviter acute acuminata, utrinque levia, glaberrima, 15—25 cm longa, 5—7 cm lata, nervis venisque densis, utrinque inconspicuis, tenuiter prominulis; petiolo semitereti. Cymae femineae sessiles, 2-5-florae. Fructus mediocris, ovoideus, dense tuberculatus, primo tomentosus, denique glabratus, 8-10-locularis; seminibus albumine aequabile; calice profunde 4-5-lobato, utrinque velutino; lobis ovatis acutis, medio incrassatis, marginibus dilatatis, inter lobos saccatim confluentibus, 0.5—0.7 cm longis, 1 cm latis.—Peninsula malayana (RIDLEY 13051; HENDERSON 22468).

16. **D. amboinensis** BAKH., spec. nov.—Arbor. Folia coriacea, oblongo-obovata, 20—35 cm longa, 5—12.5 cm lata, basi rotundata vel subcordata, apice breviter acute acuminata, subtus sericea, denique glabrescentia; petiolo brevi, semitereti. Fructus magnus, depresso-globosus, maturitate glabratus; seminibus albumine aequabile; calice 5-fido, intus glabro.—Ambon (TEYSMANN HB. 1917).

17. **D. apiculata** HIERN.

18. **D. areolata** KING et GAMBLE.

19. **D. argentea** GRIFF.

20. **D. aurea** TEYSM. et BINNEND.

21. **D. Baloen-idjoek** BAKH., spec. nov.—Arbor mediocris. Folia elliptico-oblonga, 2—10 cm longa, 1—3.5 cm lata, basi obtusa vel rotundata, apice obtuse acuminata, subtus primo appresse pilosa, denique costa excepta glabra, penninervia, costa utrinque prominula, nervis utrinsecus 5-7, basalibus ceteris longioribus, venis utrinque inconspicuis; petiolo tereti, tomentoso, 0.3—1 cm longo. Flores dioici, 4-meri;—masculi breviter cymosi, terni; cymis bibracteatis; calice profunde partito, extus tomentoso, intus glabro; tubo subnullo; lobis imbricatis, suborbicularibus, ciliatis, 0.15—0.2 cm longis, 0.1—0.15 cm latis; corolla hypocrateriforme, extus sericea, intus glabra, 1—1.5 cm longa; staminibus 8-16, pubescentibus.—Sumatra (Boschpr. bb. 9147, nom. vulg.: Baloen idjoek, Mal.).

22. **D. bangkana** BAKH., spec. nov.—Frutex; ramulis virgatis, juniores rufo-hirtis. Folia ovato-oblonga vel oblanceolata, 2.5—12 cm longa, 1.5—5 cm lata, basi cuneata vel obtusa, apice abrupte breviter acuminata, costa excepta utrinque glabra; petiolo subtereti, rufo-hirto, 0.3—0.7 cm longo. Aff. *D. malaccensis* BAKH.—Ins. Bangka (TEYSMANN 3404 HB.).

23. **D. bantamensis** KDS. et VAL., msc.—Arbor mediocris. Folia firmiter coriacea, ovato-oblonga vel oblongo-elliptica, 4—12 cm longa, 1.5—4 cm lata, basi obtusa vel rotundata, apice acuminata, nervis utrinsecus 5—10, cum venis tenuibus utrinque prominulis; petiolo semitereti, 0.5—1 cm longo. Fructus solitarius, brevissime pedunculatus, depresso-globosus, maturitate glabrescens, 4—6 cm diam.; seminibus 4-8, albumine ruminato; calice 4-lobato, utrinque tomentoso; lobis late ovatis reflexis, 0.7—1 cm longis, 1—2 cm latis.—Java, Bantam (KOORDERS 1718*β*.).

24. **D. Beccarii** HIERN.

25. **D. bibracteata** BAKH., spec. nov.—Arbor mediocris; ramulis verruculoso-lenticellatis. Folia chartacea, ovato-oblonga vel obverse oblonga, 17.5—35 cm longa, 7—11 cm lata, basi obtuse cuneata, apice breviter obtuse acuminata, glabrescentia, nervis utrinsecus 10-12, venis laxis obscuris, utrinque prominulis; petiolo semitereti. Flores feminei

solitarii vel terni, pedunculati; pedunculo bibracteato; calice coriaceo, utrinque pubescente, medio 4-lobato; lobis late ovatis, obtusis vel rotundatis, marginibus reflexis; ovario globoso, sericeo, 8-loculare; loculis uniovulatis. Aff. *D. perfidae* BAKH.—Pahang (HENDERSON 24512).

26. **D. borneënsis** HIERN.

27. **D. brevicalyx** BOERL. et KDS. ex KDS., in KDS.—SCHUM., Syst. Verzeich., II, Sumatra (1911) 50.

28. **D. buxifolia** (BL.) HIERN.

29. **D. campanulata** BAKH., spec. nov.—Folia chartacea, oblongo-elliptica vel lanceolato-oblonga, 9—20 cm longa, 3.5—8 cm lata, basi obtusa, apice subcaudato-obtusiuscule acuminata, costa excepta utrinque glabra, nervis utrinsecus 10-15, venis laxis, utrinque prominulis; petiolo semitereti, 1—1.25 cm longo. Fructus solitarius, pedunculatus, globosus, nitidus, glaber; calice valde accrescente, quadrangulare campanulato, utrinque glaberrimo, 2—3 cm longo, 3.5—5 cm diam., tubo cruciato, crasso; lobis marginibus dilatatis, coriaceis, nervosis, confluentibus, inter lobos saccatis.—Borneo (TEYSMANN 7962 HB.).

30. **D. cauliflora** BL.

31. **D. celebica** BAKH., spec. nov.—Arbor mediocris; ramulis sericeis. Folia coriacea, lineari elliptica, 12—35 cm longa, 2.5—7 cm lata, basi angustata, apice acuminata, supra nitida, glabra, subtus glauca, sericea, nervis densis, venis tenuibus, utrinque prominulis; petiolo semitereti, sericeo, 0.3—1 cm longo. Flores 4-meri;—feminei solitarii;—masculi cymosi; calice utrinque sericeo vel intus glabrescente, lobis ovato-oblongis, basi unilateraliter cordatis, obtusis vel rotundatis, 0.5—0.7 cm longis, 0.3—0.5 cm latis; corolla hypocrateriforme; staminibus 16, sessilibus. Fructus subsessilibus, ovoideus, primo sericeus, denique glabratus; seminibus 4-8, albumine aequabile; calice intus glabrescente, 2 cm diametro.—Celebes (HEYNE 2564 et 2878).

32. **D. clavipes** BAKH., spec. nov.—Folia chartacea, oblongo-elliptica, 9—15 cm longa, 4—6 cm lata, basi cuneata, apice breviter acuminata, subtus glabrescentia, basi glandulis 2-4, nervis utrinsecus 6-10; petiolo semitereti, 0.5—1 cm longo. Fructus

pedunculatus, depresso-globosus, tomentosus, 3—3.5 cm diam.; seminibus albumine aequabile; calice campanulato, utrinque pubescente, leviter 4-lobato; lobis late ovatis, 0.5—0.7 cm longis, 1.5—2 cm latis.—Borneo (TEYSMANN 11397 HB.).

33. **D. Clementium** BAKH., spec. nov.—Frutex; ramulis virgatis, piloso-hispidis, glabrescentibus. Folia brevissime petiolata, membranacea, lineari-oblonga, 1.5—4 cm longa, 0.5—1 cm lata; basi rotundata vel leviter cordata, apice angustata, obtusa, margine ciliata, dense pellucido-punctata, subtus sparse pilosa, penninervia, nervis subdensis, subinconspicuis; petiolo tereti, rufo-hispido, 0.1 cm longo. Aff. *D. subrhomboideae* K. et G.—Borneo, Sarawak (J. et M.S. CLEMENS 20098).

34. **D. conformis** BAKH., spec. nov.—Arbor mediocris. Folia coriacea, elliptico-oblonga, basi late cuneata, apice subabrupte acuminata, utrinque rugosa, glabra, nervis cum venis utrinque prominulis; petiolo semi-tereti, glabro, 1—1.5 cm longo. Flores feminei solitarii, longiter pedunculati; calice campanulato, 4-5-lobato, intus pubescente. Fructus pedunculatus, submagnus, ovoideo-globosus, glaber, 8-locularis; loculis monospermis; seminibus albumine ruminato; calice applanato, subquadro, statu sicco sublignoso, intus tomentoso, 3—4 cm diam.—Perak (HAMID 10384).

35. **D. confusa** BAKH., spec. nov.—Folia chartacea, oblonga vel lanceolato-oblonga, 5.5—8.5 cm longa, 1.5—3 cm lata, basi obtuse cuneata, apice acuminata, subtus appresse pubescentia, pellucido-punctata, nervis venisque tenuibus, utrinque leviter prominulis; petiolo tereti, tomentoso, 0.2—0.5 cm longo. Flores dioici;—masculi subsessiles, cymosi; calice 4-fido, extus pubescente, intus glabro, lobis ovatis, obtusis vel rotundatis, 0.3—0.35 cm longis, 0.2—0.25 cm latis; corolla hypocrateriforme, extus sericea, intus glabra; staminibus—12, glabris.—Hort. Bot. Singapore (C. A. BAKER).

36. **D. cordata** (HIERN) BAKH., comb. nov.—*Maba cordata* HIERN.

37. **D. coriacea** HIERN.

38. **D. crassipes** BAKH., spec. nov.—Folia chartacea, lanceolato-oblonga, 7—15 cm longa, 2.5—6 cm

lata, basi cuneata, apice breviter subcaudato-acuminata, utrinque glabra, dense pellucido-punctata, basi glandulis 2-4, nervis utrinsecus 4-7; petiolo semitereti, glabro, 0.5—1 cm longo. Fructus breviter pedunculatus, rufo-hispidus, glabrescens; calice late campanulato, medio 4-lobato, intus pubescente, lobis deltoideis, erectis; pedunculo tumido. Aff. *D. clavipedis* BAKH.—Borneo, Sarawak (BECCARI 2041).

39. **D. cubica** BAKH., spec. nov.—Arbor; ramulis glabris. Folia coriacea, elliptico-oblonga, 15—20 cm longa, 7—9 cm lata, basi obtusa, apice breviter acuminata, utrinque glabra, nervis utrinsecus 10—15, supra cum venis inconspicuis, impressis; petiolo semitereti, glabro ± 1 cm longo. Fructus solitarius, subsessilis, statu sicco subcubicus, basi apiceque truncatus, verrucosus, glaber; seminibus 8-10; calice reflexo, profunde 5-lobo, intus basi excepta glabro, lobis ovatis. Aff. *D. oblongae* WALL. ex G. DON.—Borneo, Sarawak (BECCARI 830).

40. **D. Curranii** MERR.

41. **D. curraniopsis** BAKH., spec. nov.—Arbor parva. Folia membranacea, oblonga vel lanceolata, 5—20 cm longa, 1.5—7 cm lata, basi cuneata, apice acuminata, utrinque mox glabra, penninervia, nervis lateralibus laxis, tenuibus, venis inconspicuis; petiolo semitereti, glabro, 0.5—1.5 cm longo. Flores dicici, 4-5-meri; calice utrinque tomentoso; —masculi cymosi; staminibus 12-24, glabris;— feminei ovario sericeo 4-5-loculare; loculis uniovulatis. Fructus breviter pedunculatus, globosus, glabrescens, 1.5—2 cm diametro; seminibus albumine aequabile; calice 1.25—1.75 cm diam., lobis late ovatis, marginibus reflexis. Aff. *D. Curranii* MERR.—Borneo (ENDERT 4883; ELMER 21464; Boschpr. bb. 13037).

42. **D. dajakensis** BAKH., spec. nov.—Arbor mediocris. Folia coriacea, oblongo-lanceolata, 12—25 cm longa, 3.5—8.5 cm lata, basi obtusa vel rotundata, apice breviter acuminata, subtus primo pubescentia, denique glabrescentia; nervis lateralibus 6-8, tenuibus, laxis, venis obscuris, prominulis; petiolo semitereti, 1—1.5 cm longo. Fructus solitarius, breviter pedunculatus. Aff. *D. tristis* K. et G.—Borneo (Boschpr. bb. 10490).

43. **D. demona** BAKH., spec. nov.—Arbor mediocris; innovationibus basi bracteis pluribus imbricatis. Folia coriacea, oblonga, basi rotundata, apice obtusa, subtus subvelutina, nervis lateralibus utrinsecus 10-15, cum venis supra impressis; petiolo subtereti, rufo-hirto, 0.5—0.75 cm longo. Flores dioici; feminei solitarii, subsessiles, bracteis imbricatis 4-6 suffulti. Fructus subglobosus, 6—8 cm diametro; seminibus 8, albumine aequabile; calice parvo, 4-lobato, extus sericeo, intus glabro, 1.2—1.5 cm diametro; lobis late ovatis vel subreniformibus.—Pahang (HENDERSON 25030).

44. **D. densa** BAKH., spec. nov.—Arbor parva; ramulis subdensis. Folia densa, chartacea, oblonga, 2.5—7.5 cm longa, 1—2.5 cm lata, basi obtuse cuneata, apice breviter anguste acuminata, costa excepta utrinque glabra, nervis lateralibus utrinsecus 6-9, supra inconspicuis; petiolo semitereti, setoso, 0.3—0.5 cm longo. Aff. *D. poiënsis* BAKH., *D. setosae* BAKH. et *D. singaporensis* BAKH.—Borneo (Boschpr. bb. 11018).

45. **D. dictyoneura** HIERN.

46. **D. Diepenhorstii** MIQ.

47. **D. discocalyx** MERR.

48. **D. discolor** WILLD.

49. **D. durionoides** BAKH., spec. nov.—Arbor alta; ramulis primo sericeis, denique glabrescentibus. Folia chartacea, elliptico-oblonga, 7—20 cm longa, 2.5—7 cm lata, basi obtusa, apice breviter acuminata, supra costa excepta glabra, subtus primo sericea, denique glabrescentia, nervis lateralibus densis, cum venis utrinque prominulis; petiolo semitereti, sericeo, 0.5—1.25 cm longo. Aff. *D. Poncei* MERR.—Borneo (Boschpr. bb. 7978, 10050 et 12456).

50. **D. Ebenum** KOEN.

51. **D. elegantissima** BAKH., nom. nov.—*Maba elegans* RIDL.—**Plate XLIX.**

52. **D. ellipsoidea** KING et GAMBLE.

53. **D. elliptifolia** MERR.

54. **D. Elmeri** MERR.

55. **D. Enderti** BAKH., spec. nov.—Folia tenuiter coriacea, elliptico-oblonga, 20—45 cm longa, 6—13 cm lata,

basi obtusa vel subcordata, apice obtusiuscule acuminata, subtus sparse pubescentia, glabrescentia, nervis utrinsecus 15-30, supra tenuiter conspicuis, venis reticulatis densis, utrinque prominulis; petiolo semitereti, tomentello, 1—2.5 cm longo. Fructus solitarius, pedunculatus, ovoideo-globosus, glaber, 5—6 cm diam.; seminibus 8-10, albumine valde ruminato; calice utrinque tomentello, 3—4 cm diam., tubo crasso, lobis late ovatis, marginibus coriaceis, inter lobos saccatim confluentibus, 1—1.5 cm longis.—Borneo (ENDERT 4017).

56. **D. eriantha** CHAMP. ex BENTH.

57. **D. eucalyptifolia** BAKH., spec. nov.—Arbuscula; ramulis glabris. Folia tenuiter coriacea, lanceolata, 9—25 cm longa, 1.5—4.5 cm lata, utrinque angustata, apice subcaudato-acuminata, utrinque glabra, nervis lateralibus utrinsecus 7-10, venis laxis, subinconspicuis; petiolo semitereti, glabro, 0.2—0.5 cm longo. Fructus solitarius, breviter pedunculatus, ovoideus, apiculatus, nitidus, glaber, 8-locularis, loculis monospermis; calice profunde 4-lobato, tubo cruciatim incrassato, lobis ovatis, acutis, coriaceis, nervosis. Aff. *D. truncatae* ZOLL. et MOR.—Borneo (AMDJAH 255).

58. **D. euphlebia** MERR.

59. **D. Everettii** MERR.

60. **D. ferox** BAKH., spec. nov.—Ramuli juniores ferrugineo-pilosi. Folia chartacea, elliptico-oblonga vel oblanceolata, 5—11 cm longa, 2—3.5 cm lata, basi subrotundata, apice acuminata vel acuta, subtus sparse pilosa, nervis lateralibus utrinsecus 15-20, supra inconspicuis, venis densis; petiolo tereti, rufo-piloso, 0.15—0.3 cm longo. Fructus solitarius, gracile pedunculatus, ovoideo-conicus, stylo rudimento apiculatus, rufo-setulosus, 4-locularis, 1.5—2 cm longus, 1—1.5 cm diam.; seminibus 4; calice 4-5-fido, extus rufo-setuloso, intus subglabro, lobis linearibus, 1.5—2 cm longis, ± 0.1 cm latis.—Borneo (Native Coll. 137).

61. **D. Forbesii** BAKH., spec. nov.—Arbuscula; ramulis verticillatis, rufo-puberulis. Folia chartacea, elliptico-oblonga, 4—12 cm longa, 2—4.5 cm lata, basi obtusa, apice breviter acuminata, subtus appresse

pubescentia, dense pellucido-punctata, nervis lateralibus utrinsecus 6-10, supra impressis, venis inconspicuis; petiolo tereti, rufo-puberulo, 0.2—0.35 cm longo. Flores dioici; feminei solitarii, subsessiles, 4-5-meri; calice profunde lobato, extus pubescente, intus glabro, lobis lineari-oblongis; ovario ovoideo, piloso, 4 loculare, loculis uniovulatis. Fructus ellipsoideus, sparse setulosus; seminibus albumine aequabile; calicis lobis 0.2—0.25 cm longis, 0.07—0.1 cm latis.—Borneo (Boschpr. bb. 12587; FORBES 3126).

62. **D. Foxworthyi** BAKH., spec. nov.—Arbor mediocris. Folia coriacea, lanceolato-oblonga, 7—25 cm longa, 2—8 cm lata, basi obtusa, apice acuminata, costa excepta utrinque glabra, nervis lateralibus utrinsecus 7-12, supra obscuris, impressis, venis inconspicuis; petiolo semitereti, glabrato, 1—1.5 cm longo. Flores dioici; masculi cymosi; calice profunde 4-lobato, intus pubescente, lobis anguste oblongis, acutis; corolla hypocrateriforme, lobis suborbicularibus, utrinque tomentellis. Fructus solitarius, breviter pedunculatus, globosus, maturitate glabratus, 3.5—4.5 cm diam., 8-locularis, loculis monospermis; seminibus albumine aequabile; calice crasso, intus tomentoso, ± 2 cm diam. —Perak (FOXWORTHY 10447; DEMALI 1220).

63. **D. frutescens** BL.

64. **D. Gambleana** BAKH., spec. nov.—Ramuli glabri. Folia coriacea, lanceolato-oblonga, 20—26 cm longa, 5—7.5 cm lata, basi cuneata, apice breviter obtuse acuminata, utrinque glabra, nervis lateralibus utrinsecus 10-15, supra leviter impressis, venis inconspicuis; petiolo subtereti, glabro, 1—1.25 cm longo. Fructus ovoideus, apiculatus, glaber, 2—3 cm longus, 1.5—2.5 cm diam.; seminibus 4, albumine aequabile; calice profunde 4-fido, utrinque glabro, 0.5—0.7 cm diametro, lobis suborbicularibus, ciliatis, imbricatis, 0.3—0.35 cm diametro, Aff. *D. Kingii* BAKH. et *D. Hiernianae* (K. et G.) BAKH.—Perak (Gunong Keledang—RIDLEY—X, 1898).

65. **D. glaucophylla** BAKH., spec. nov.—Arbor mediocris. Folia chartacea, oblonga vel oblanceolata, 5—15 cm longa, 2—6 cm lata, basi cuneata, apice breviter acuminata, subtus glauco-pruinosa; nervis lateralibus utrinsecus 7-12, supra inconspicuis,

prominulis; petiolo semitereti, glabrescente, 0.5—0.75 cm longo. Aff. *D. Havilandi* BAKH.—Sumatra (Boschpr. bb. 13016).

66. **D. graciliflora** HIERN.

67. **D. Greshoffiana** KDS., msc.—Arbor mediocris; ramulis glabrescentibus, in sicco griseis. Folia tenuiter coriacea, oblongo-elliptica, 7-17 cm longa, 3.5—5.5 cm lata, basi obtuse cuneata, apice obtusa, subtus appresse pubescentia, denique glabrescentia, basi glandulis orbicularibus, nervis lateralibus utrinsecus 7-10, tenuibus, venis inconspicuis; petiolo semitereti, glabrescente, 1—1.5 cm longo. Flores dioici, 4-5-meri. Fructus breviter pedunculatus vel subsessilis, depresso-globosus, cinereo-sericeus, 1.5—2.5 cm diametro; seminibus 8-10, albumine aequabile; calice patelliforme, leviter 4-5-lobato, intus sericeo, 1.5—2.5 cm diam.; tubo incrassato, 4-5-angulato, lobis late ovatis, marginibus anguste dilatatis.—Celebes (KOORDERS 16746β, 16750β, 16764β et 16767β).

68. **D. Hackenbergii** DIELS.

69. **D. Hallierii** BAKH., spec. nov.—Arbor mediocris; ramulis crassis, mox glabris. Folia coriacea, obverse oblonga, 20—40 cm longa, 5—13 cm lata, basi obtusa, apice acuminata, subtus mox glabra, nervis lateralibus utrinsecus 12-25, supra subinconspicuis, leviter impressis; venis reticulatis densis, utrinque obscure prominulis; petiolo crasso, semitereti, 1—1.5 cm longo. Flores dioici, 4-5-meri, subcorymbosi; calice intus glabro; corolla urceolato-oblonga, extus pubescente;—masculi staminibus 16-20, inaequalibus, antheris dorso pubescentibus;—feminei ovario ovoideo, rufo-tomentoso, 8-10-loculare, loculis uniovulatis. Fructus depresso-globosus, maturitate glabrescens, 5—7 cm diam.; seminibus albumine ruminato; calice crasso, plano, 4-6-lobato, 3.5—5 cm diam.—Borneo (HALLIER fil. 2854).

70. **D. Hasseltii** ZOLL.

71. **D. Havilandi** BAKH., spec. nov.—Folia coriacea, oblongo-elliptica vel oblanceolata, 3—8 cm longa, 1.5—4 cm lata, basi cuneata, apice subobtusa, utrinque glaberrima, subtus in sicco glauca, nervis venisque utrinque inconspicuis; petiolo semitereti, subglabro, 0.5—0.7 cm longo. Flores dioici, pedunculati, 4-meri;—masculi subracemosi, nutantes,

± 1.5 cm longi; calice 4-fido, intus glabro, lobis suborbicularibus, contortis, ciliatis, 0.25—0.3 cm diam.; corolla hypocrateriforme, extus sericea, intus glabra; staminibus 12, inaequalibus, glabris; antheris lanceolatis.—Borneo, Sarawak (HAVILAND 2315).

72. **D. hebecarpa** CUNN. ex BENTH.

73. **D. Helferi** CLARKE.

74. **D. Hendersoni** RIDL.

75. **D. Hierniana** (KING et GAMBLE) BAKH., comb. nov.—*Maba Hierniana* KING et GAMBLE.

76. **D. insidiosa** BAKH., spec. nov. **Plate L.**—Arbor mediocris. Folia chartacea, ovato-oblonga, 5—17 cm longa, 2—7 cm lata, basi cuneata vel obtusa, apice breviter obtuse acuminata, costa excepta utrinque glabra, dense pellucido-punctata, nervis lateralibus utrinsecus 5-7, cum venis inconspicuis utrinque prominulis; petiolo subtereti, glabrescente, 0.5—0.7 cm longo. Fructus brevissime pedunculatus, subglobosus, basi contractus, apice rotundatus, laevis, glaber, 6—7 cm diam.; seminibus 8, albumine aequabile; calice parvo, inconspicuo, 0.3—0.5 cm diametro, lobis late triangularibus obtusis, extus pubescentibus, intus glabris.—Pahang (HENDERSON 21730).

77. **D. insularis** BAKH., spec. nov.—Folia tenuiter coriacea, oblonga-elliptica, 20—25 cm longa, ± 10 cm lata, basi cordata, subobliqua, apice angustata, in exemplum praemorsa, utrinque glabra; nervis lateralibus utrinsecus 10-12, utrinque prominentibus, venis laxis utrinque prominulis, basi glandulis orbicularibus; petiolo crassiusculo, tereti, glabro, 0.5—0.7 cm longo. Flores dioici; masculi dense fasciculati, subsessiles, 1.25—1.5 cm longi; calice cupuliforme, undulato 4-dentato vel subtruncato, intus pubescente, 0.4—0.5 cm diam.; corolla tubulosa, medio 4-lobata, extus pubescente, intus glabra; lobis late ovatis, contortis; staminibus numerosis, inaequalibus; antheris linearibus, dorso pubescentibus. Aff. *D. novoguineënsis* BAKH.— Nova Guinea, New Ireland (G. PEEKEL 4A—VI. 1921).

78. **D. Jaherii** BAKH., spec. nov.—Ramuli tomentosi. Folia membranacea, ovato-oblonga, 4—12.5 cm

longa, 2—5.5 cm lata, basi obtuse cuneata, apice breviter obtuse acuminata, utrinque costa excepta glabra, dense pellucido-punctata; nervis lateralibus 4-7, supra tenuibus impressis, venis inconspicuis; petiolo subtereti, tomentoso, 0.2—0.5 cm longo. Flores dioici 4-5-meri; masculi cymosi, subsessiles; calice profunde lobato, extus puberulo, intus glabro, lobis ovoideis, contortis, ciliatis, 0.3—0.35 cm longis, 0.2—0.25 cm latis; corolla hypocrateriforme, extus sericea, intus glabra, medio lobata; staminibus 16, inaequalibus; antheris oblongis, dorso pubescentibus.—Borneo (JAHERI 128).

79. **D. javanica** BAKH., spec. nov.—Arbor; ramulis mox glabris. Folia tenuiter coriacea, lanceolato-oblonga, 10—30 cm longa, 3—10 cm lata, basi obtusa vel rotundata, apice obtusa, utrinque mox glabra, basi glandulis 2 orbicularibus conspicuis; nervis lateralibus utrinsecus 7-10, cum venis tenuibus; petiolo semitereti, glabro, 0.5—1.5 cm longo. Flores dioici, subsessiles, 4-5-meri; calice intus sericeo; corolla ovoideo-oblonga, extus pilis reversis sericea, intus glabra;—masculi cymosi; staminibus 18, filamentis brevissimis, hispidis, antheris linearibus, apiculatis, glabris;-feminei solitarii; calice campanulato, profunde lobato, tubo subquadrato, lobis late ovatis, marginibus dilatatis, coriaceis, subplicatis; staminibus 8; ovario 8-10-loculare, loculis uniovulatis. Fructus depresso-globosus, primo sericeus, maturitate glabrescens, 2—2.5 cm diam.; seminibus albumine aequabile; calice subpatelliforme, 1.5—2 cm diam.—Java (BACKER 11807; KOORDERS 20026β, 22007β, 26878β et 39997β).

80. **D. Kaki** LINN. fil.

81. **D. Kingii** BAKH., spec. nov.—Arbuscula; ramulis glaberrimis. Folia tenuiter coriacea, oblonga, 9—13 cm longa, 3—5 cm lata, basi cuneata, apice obtusiuscula acuminata, utrinque glabra; nervis lateralibus utrinsecus 7-10, supra obscure prominulis, venis inconspicuis; petiolo semitereti, glabro, 0.5—1 cm longo. Fructus solitarius, subsessilis, ovoideus, apiculatus, glaberrimus, $\pm$ 1.5 cm diametro; calice profunde 4-fido, utrinque glabro, 0.5 cm diam.; lobis orbicularibus, imbricatis, ciliatis. Aff. *D. brevicalycis* BOERL. et KDS. ex KDS. et *D. Gambleanae* BAKH.—Perak (KING'S Coll. 3072).

82. **D. koeboeënsis** BAKH., spec. nov.—Arbor mediocris; ramulis glabrescentibus. Folia tenuiter coriacea, elliptica-oblonga, 7—20 cm longa, 2.5—6 cm lata, basi obtuso-cuneata, apice breviter obtuse acuminata, utrinque mox glabra; nervis lateralibus utrinsecus 5-9, cum venis reticulatis utrinque prominulis distinctis; petiolo semitereti, glabrescente, 1—1.75 cm longo. Flores dioici; masculi cymosi, pedunculati, terni; calice urceolato, leviter 4-dentato, utrinque pubescente, 0.4—0.5 cm longo; corolla carnosa, extus sericea, intus glabra; staminibus 12-16, filamentis cum antheris dorso pubescentibus. Aff. *D. malabaricae* (DESR.) KOSTEL.—Sumatra, Banjoeasin en Koeboestreken (Boschpr. T. 741).

83. **D. Korthalsiana** HIERN.

84. **D. Kurzii** HIERN.

85. **D. lanceifolia** ROXB.

86. **D. lateralis** HIERN.

87. **D. latisepala** RIDL.

88. **D. levigata** BAKH., spec. nov.—Arbor mediocris; ramulis rufo-tomentellis. Folia coriacea, elliptico-oblonga, 8—30 cm longa, 3—12 cm lata, basi obtuse cuneata vel subrotundata, apice obtuse acuminata, costa venisque excepta utrinque glabra; nervis lateralibus utrinsecus 10-15, supra obscuris, subimpressis, secus marginem curvatis, anastomosantibus, venis reticulatis laxis, supra inconspicuis; petiolo semitereti, rufo-tomentello, 1—2 cm longo. Aff. *D. rufae* K. et G. et *D. Foxworthyi* BAKH.—Borneo (Boschpr. bb. 8053, 11089, 11255).

89. **D. Lolin** BAKH., spec. nov.—Arbor mediocris; ramulis sericeis, denique glabrescentibus. Folia coriacea, oblongo-elliptica, 10—25 cm longa, 6—10 cm lata, basi subrotundata, apice obtusa, breviter apiculata, supra nitida, glabra, subtus primo strigosa, glabrescentia; nervis lateralibus subdensis, supra inconspicuis, cum venis utrinque prominulis; petiolo semitereti, glabrescente, 0.7—2 cm longo. Flores dioici; calice 4-5-fido, extus sericeo, intus glabro; lobis suborbicularibus, imbricatis, 0.3—0.5 cm diam.; corolla tubulosa, extus sericea, intus glabra;—masculi breviter cymosi, 3-5-ni, cernui; staminibus 16-24, per paria vel pluria fasciculatis,

glabris;—feminei ovario pubescente, 8-10-loculare, loculis uniovulatis. Fructus subsessilis, depresso-globosus, apice umbilicatus, maturitate glaber, 3.5—4 cm vel ultra diam.; seminibus albumine aequabile; calice non vix accrescente, 1—1.5 cm diam.—Moluccae (ATASRIP 46; BEGUIN).

90. **D. macrophylla** BL.

91. **D. malabarica** (DESR.) KOSTEL.

92. **D. malaccensis** BAKH., spec. nov.—Arbor mediocris; ramulis glabris. Folia tenuiter coriacea, oblonga vel oblanceolata, 3.5—13.5 cm longa, 2.5—6.5 cm lata; basi cuneata, apice abrupte breviter obtuse acuminata, costa excepta utrinque glabra; nervis lateralibus utrinsecus 5-7, supra cum venis inconspicuis, leviter prominulis; petiolo semitereti, glabrescente, 0.7—1.2 cm longo. Fructus breviter pedunculatus, globosus, styli rudimento apiculatus, maturitate glabrescens, 4-locularis, 4-spermus, 1—1.5 cm diam.; seminibus albumine aequabile; calice profunde 4-fido, utrinque glabro; lobis late ovatis vel suborbicularibus, ciliatis, patentibus, 0.2—0.3 cm diametro. Aff. *D. Hiernianae* (K. et G.) BAKH.—Malacca (RIDLEY 657); Dindings (HAMID C. F. 2322).

93. **D. Malam** BAKH., spec. nov.—Arbor mediocris; ramulis tomentosis, glabrescentibus. Folia coriacea, oblongo-elliptica, 5—17.5 cm longa, 3—7.5 cm lata, basi obtusa, apice obtuse acuminata, utrinque mox glabra; nervis lateralibus utrinsecus 7-15, supra cum venis obscuris, leviter prominulis; petiolo semitereti, tomentoso, glabrescente, 0.7—1.5 cm longo. Flores dioici, pedicellati; calice campanulato, profunde 4-lobato, basi angustato, utrinque tomentoso-subvelutino; corolla ovoidea, 4-lobata, extus tomentosa, intus glabra;—masculi staminibus 20, subsessilibus, antheris oblongis apiculatis, glabris;—feminei staminodiis ± 8, glabris; ovario ovoideo, rufo-velutino, 8-loculare, loculis uniovulatis.—Borneo (Boschpr. bb. 6335, 8037—nom. vulg.: Malam, Kajoe malam).

94. **D. maritima** BL.

95. **D. micromera** BAKH., spec. nov.—Ramuli nigro-tomentosi. Folia coriacea, brevissime petiolata, lanceolato-oblonga, 3—6 cm longa, 0.7—1.7 cm lata, basi leviter cordata, apice acuminata, costa

excepta utrinque glabra, supra nitida; nervis lateralibus utrinsecus 6-9, cum venis obscuris utrinque prominulis; petiolo tereti, tomentoso, 0.15—0.3 cm longo. Flores 5-7-ni, in racemis dispositi. Aff. *D. apiculatae* HIERN.—Perak (CURTIS 3463).

96. **D. Minahasae** BAKH., spec. nov.—Arbor; ramulis primo tomentosis, denique glabratis. Folia tenuiter coriacea, oblonga, 5—25 cm longa, 2.5—10 cm lata, basi cuneata vel obtusa, apice breviter obtuse acuminata, subtus primo tomentosa, denique glabrescentia, dense pellucido-punctata; nervis lateralibus utrinsecus 7-12, statu sicco supra tenuibus, impressis, venis obscuris, utrinque prominulis; petiolo subtereti, tomentoso, 0.4—1.5 cm longo. Flores cymosi, dioici vel polygami, 4-meri; calice lobato, extus pubescente, intus glabro; corolla hypocrateriforme, extus pubescente, intus glabra;—masculi staminibus 16, inaequalibus, glabris;—feminei, calicis lobis late ovatis, acutis, striatis, 0.5—0.7 cm longis, 0.7—1 cm latis; ovario glabro, 8-loculare, loculis uniovulatis. Fructus subsessilis, subglobosus, 2—2.5 cm diam.; seminibus albumine aequabile.—Celebes (KOORDERS 16753β, 16766β et 16770β).

97. **D. mindanaënsis** MERR.

98. **D. minutiflora** BAKH., spec. nov.—Arbor mediocris; ramulis virgatis, puberulis. Folia tenuiter coriacea, elliptico-oblonga, 2.5—11 cm longa, 1—4.5 cm lata, basi obtuse cuneata, apice breviter acuminata, subtus pilosa vel glabrescentia; nervis lateralibus utrinsecus 5-7, supra cum venis inconspicuis; petiolo tereti, puberulo, 0.15—0.5 cm longo. Flores dioici, 4-meri;—feminei breviter pedunculati; calice 4-fido, extus pubescente, intus glabro; lobis subreniformibus, contortis, ciliatis, 0.25—0.3 cm diam.; corolla ovoidea, utrinque glabra. Aff. *D. lateralis* HIERN. et *D. oliganthae* MERR.—Sumatra (BEGUIN 265).

99. **D. montana** ROXB.

100. **D. muricata** BAKH., spec. nov.—Ramuli sparse pilosi. Folia coriacea, elliptico-oblonga, 10—25 cm longa, 3.5—8 cm lata, basi leviter cordata, apice acuminata, costa excepta utrinque glabra; nervis lateralibus utrinsecus 10-15, supra tenuibus, cum venis obscuris utrinque prominulis; petiolo tereti, sparse

hispido, 0.3—1.25 cm longo. Flores dioici;- feminei fasciculati, subsessiles; calice 4-5-fido, extus piloso, intus glabro, lobis ovato-oblongis, acuminatis, 0.25—0.35 cm longis, 0.15—0.2 cm latis; ovario rufo-hispido, 4-5-loculare, loculis uniovulatis. Fructus ovoideo-globosus, muricato-mamillatus, tomentosus et pilis longis hispidis, 2—2.5 cm diam.; seminibus albumine aequabile; calice non vix accrescente. Aff. *D. ferocis* BAKH.—Borneo (JAHERI 644; HAVILAND 3483).

101. **D. myrmecocalyx** (HIERN) BAKH., comb. nov.—*Maba myrmecocalyx* HIERN.

102. **D. nana** BAKH., spec. nov.—Frutex; ramulis tomentosis, glabrescentibus. Folia tenuiter coriacea, oblonga, 12—22 cm longa, 4.5—8 cm lata, basi subrotundata, apice longiter acuminata, costa excepta utrinque glabra; nervis lateralibus utrinsecus 8-10, supra impressis, venis inconspicuis; petiolo subtereti, tomentello vel glabrescente, 0.7—1 cm longo. Fructus solitarius, breviter pedunculatus, ovoideo-oblongus, acuminatus, appresse pilosus, 3—3.5 cm longus, 1.5—2 cm diam.; seminibus 4, albumine aequabile; calice parvo, 4-fido, 0.7—0.8 cm diametro, lobis suborbicularibus, ciliatis, extus pilosis, intus glabris, 0.3—0.4 cm diametro. Aff. *D. ellipoideae* K. et G.—Perak (WRAY 3214).

103. **D. nemorosa** BAKH., spec. nov.—Arbor, ramulis rufo-velutinis. Folia coriacea, elliptico-oblonga, 15—25 cm longa, 7—9 cm lata, basi rotundata, apice breviter obtuse acuminata, primo utrinque velutina, denique costa excepta supra glabra, nitida, subtus glabrescentia; nervis lateralibus utrinsecus 8-12, supra impressis, venis utrinque inconspicuis; petiolo subtereti, velutino, 1—1.5 cm longo. Fructus globosus, rufo-velutinus, (immaturo) 2.5—3 cm diam.; seminibus 8, albumine aequabile; calice profunde 4-lobato, crasso, utrinque rufo-velutino; lobis ovatis obtusis, 0.5—0.7 cm diam. Aff. *D. pauciflorae* K. et G.—Borneo (Boschpr. bb. 1603).

104. **D. neurosepala** BAKH., spec. nov.—Ramuli tomentosi, glabrescentes. Folia coriacea, oblongo-elliptica, 15—30 cm longa, 6—8 cm lata, basi subrotundata, apice abrupte breviter obtuse acuminata, vetustiora utrinque glaberrima; nervis lateralibus utrinsecus 5-10, supra sulcatis, subtus prominentibus, venis obscuris, supra impressis; petiolo

subtereti, rugoso, glabro, 1.5—2 cm longo. Fructus solitarius, longiter (± 4 cm) pedunculatus, globosus, rufo-tomentosus, maturitate glabrescens, 2.5—3 cm diam.; calice valde accrescente, profunde 4-lobato, utrinque tomentoso, lobis foliaceis, late ovatis, chartaceis, palminerviis et laxe venosis, ± 3—3.5 cm diam. Aff. *D. latisepalae* RIDL.—Borneo (BECCARI 541).

105. **D. nigra** (J. F. GMEL.) PERROTT.

106. **D. nitida** MERR.

107. **D. novoguineënsis** BAKH., spec. nov.—Frutex; ramulis glabrescentibus. Folia tenuiter coriacea, lanceolato-oblonga, 12—30 cm longa, 2—7.5 cm lata, basi obtuse cuneata, apice acuminata, utrinque glabra; nervis lateralibus utrinsecus 7-9, basalibus suboppositis, venis utrinque prominulis; petiolo semitereti, glabro, 0.5—1 cm longo. Flores dioici, sessiles;- masculi fasciculati; calice cupuliforme, leviter 4-dentato, intus glabro;- corolla hypocrateriforme, extus pubescente, intus glabra; staminibus 8-10, dorso pubescentibus;- feminei solitarii; calice majore, profunde 4-lobato, utrinque pubescente, lobis oblongis, foliaceis, striatis, reflexis, 0.3—0.35 cm longis, 0.2—0.25 cm latis; staminodiis 8, glabris; ovario ovoideo, pubescente, 8-loculare, loculis uniovulatis. Fructus globosus, sericeus vel maturitate glabrescens, 2—2.5 cm diam.; seminibus albumine aequabile.—Nova Guinea (DOCTERS VAN LEEUWEN 9196; LAM 698).

108. **D. nutans** KING et GAMBLE.

109. **D. oblonga** WALL. ex G. DON.

110. **D. oligantha** MERR.

111. **D. pahangensis** BAKH., spec. nov.—Arbuscula; ramulis hispidis, deinde glabris. Folia chartacea, elliptico-oblonga, 6—12 cm longa, 1.5—2.75 cm lata, basi subrotundata, apice acuminata, subtus piloso-hispida, dense pellucido-punctata; nervis lateralibus utrinsecus 10-15, supra impressis, venis supra obscuris; petiolo tereti, rufo-hispido, 0.2—0.4 cm longo. Fructus solitarius, subsessilis, ovoideo-globosus, appresse pilosus, 4-loculare, 4-spermus, 1.5—2 cm diam.; seminibus albumine aequabile; calice 4-5-fido, extus appresse piloso, intus glabro;

lobis oblongo-lanceolatis, obtusis, ciliatis, 0.4—0.5 cm longis, 0.2—0.25 cm latis. Aff. *D. apiculatae* HIERN.—Pahang (HENDERSON 22296).

112. **D. palembanica** BAKH., spec. nov.—Arbor mediocris; ramulis rufo-tomentosis glabrescentibus. Folia coriacea, oblonga vel oblanceolata, 9—30 cm longa, 3—10 cm lata, basi subcuneata, apice breviter acuminata, subtus primo rufo-tomentosa, denique glabrescentia; nervis lateralibus utrinsecus 6-12, supra impressis, venis supra inconspicuis; petiolo subtereti, tomentoso, 0.7—1.5 cm longo. Fructus solitarius, sessilis, late ovoideus vel depresso-globosus, rugosus, primo tomentosus, maturitate glabratus, 8-10-locularis, 6-8-spermus, 4—5.5 cm longus, 5—7.5 cm diam.; seminibus albumine aequabile; calice crasso, subquadrato 4-lobo, utrinque rufo-tomentoso, 3—3.5 cm diam.; lobis late ovatis. Aff. *D. pauciflorae* K. et G.—Sumatra, Palembang (DUMAS 1560).

113. **D. papuana** VAL. nom. nud.—Arbor mediocris, ramulis glabrescentibus. Folia tenuiter coriacea, lanceolato-elliptica, 15—40 cm longa, 4—14 cm lata, basi obtusa, apice breviter obtuse acuminata, utrinque glabra; nervis lateralibus utrinsecus 12-17, supra impressis, venis reticulatis densis, utrinque prominulis; petiolo semitereti, glabro, 0.7—1.5 cm longo. Flores dioici, 4-5-meri;—masculi cymosi; calice profunde lobato, intus glabro; corolla tubulosa, extus dense pubescente, intus glabro; staminibus 12-18, pubescentibus;—feminei solitarii vel terni; calice campanulato; staminodiis 8-13, puberulis; ovario ovoideo, sericeo. Fructus depresso-globosus, maturitate glaber, 7—10 cm diam.; seminibus albumine aequabile; calice incrassato, leviter 4-5-lobato, utrinque glabrescente, 2—3 cm diam.—Moluccae, Nova Guinea.

114. **D. Paraoesi** BAKH., spec. nov.—Arbor mediocris; ramulis pilis biformibus pubescentibus, glabrescentibus. Folia chartacea, ovato-oblonga, 3—9 cm longa, 1.5—4 cm lata, basi obtuse cuneata, apice breviter acuminata, mox costa excepta utrinque glabra; nervis lateralibus utrinsecus 5-7, basalibus suboppositis, ceteris longioribus, cum venis venis inconspicuis utrinque prominulis; petiolo semitereti, puberulo, 0.3—0.5 cm longo. Aff. *D. Jaherii* BAKH.—Borneo (Boschpr. bb. 10162, nom. Daj.: Paraoesi).

115. **D. pauciflora** KING et GAMBLE.

116. **D. Peekelii** LAUTERB.

117. **D. penangiana** KING et GAMBLE.

118. **D. pendula** HASSELT ex HASSK.

119. **D. perakensis** BAKH., spec. nov.—Folia coriacea, lanceolato-oblonga, 12—25 cm longa, 3.5—10 cm lata, basi cuneata, apice acuminata, utrinque glaberrima, nervis lateralibus utrinsecus 9-12, cum venis utrinque prominulis distinctis; petiolo semitereti, glabro, 1.5—2.5 cm longo. Fructus breviter pedunculatus, ovoideo-globosus, primo tomentosus, maturitate glabratus, tuberculatus, 3.5—4 cm diam.; calice late campanulato, utrinque glabro, 2.5—3.5 cm diam., tubo incrassato, lobis marginibus dilatatis, inter lobos saccatim confluentibus. Aff. *D. rigidae* HIERN et *D. areolatae* K. et G.—Perak (WRAY 501).

120. **D. perfida** BAKH., spec. nov.—Arbor mediocris. Folia chartacea, oblonga, 7.5—25 cm longa, 2.5—8.5 cm lata, basi obtusa, apice acuminata, vetustiora utrinque glabra, dense pellucido-punctata; nervis lateralibus utrinsecus 8-12, supra leviter prominulis; petiolo semitereti, glabrescente, 0.5—1.5 cm longo. Flores dioici, 4-meri, cymosi, calice intus sericeo, lobis suborbicularibus, ciliatis, 0.2—0.3 cm diam.; corolla ovoideo-oblonga, utrinque glaberrima;—feminei staminodiis 8, glabris; ovario ovoideo, sericeo, 8-loculare, loculis uniovulatis. Fructus depresso-globosus, maturitate glabrescens, nitidus, 3—3.5 cm diam.; seminibus albumine ruminato; calice sublignoso, 3—3.5 cm diam.—Borneo (Boschw. 2327, ♀; ENDERT 2705, ♂; Boschpr. bb. 13221, ♀).

121. **D. philippinensis** A. DC.

122. **D. pilosanthera** BLANCO.

123. **D. piscicapa** RIDL.

124. **D. plectosepala** HIERN.

125 **D. poiënsis** BAKH., spec. nov.—Arbuscula; ramulis pilosis, mox glabris. Folia tenuiter coriacea, oblonga, 5—12 cm longa, 2—5 cm lata, basi cuneata, apice subcaudato-acuminata, costa excepta utrinque glabra, dense pellucido-punctata; nervis lateralibus utrinsecus 5-7, basalibus longioribus, cum

venis supra inconspicuis, leviter impressis; petiolo subtereti, rufo-hispido, mox glabro, 0.3—0.5 cm longo. Flores dioici;—feminei solitarii, subsessiles; calice 4-fido, extus puberulo, intus glabro, lobis ovato-ellipticis, ciliatis, contortis, 0.4—0.5 cm longis, 0.3—0.4 cm latis; corolla hypocrateriforme, medio 4-loba, extus puberula, intus glabra; staminodiis 4; ovario ovoideo, sericeo, 4-loculare, loculis uniovulatis. Fructus ellipsoideus, maturitate glabrescens, 2—3 cm longus, 1—1.25 cm diam.; seminibus albumine aequabile; calice non vel vix aucto, ± 1 cm diam. Aff. *D. singaporensis* BAKH. —Borneo, Mount Poi (J. et M. S. CLEMENS 20304).

126. **D. polyalthioides** KORTH. ex HIERN.

127. **D. Poncei** MERR.

128. **D. pseudo-malabarica** BAKH., spec. nov.—Arbuscula; ramulis tomentellis, denique glabrescentibus. Folia coriacea, lanceolato-oblonga, 7—17 cm longa, 2.5—6 cm lata, basi obtusa vel rotundata, apice obtuse acuminata, costa excepta utrinque glabra; nervis lateralibus utrinsecus 7-15, cum venis densis utrinque distincte prominulis; petiolo semitereti, tomentello, 1—1.25 cm longo. Fructus solitarius, brevissime pedunculatus, globosus, primo tomentellus, maturitate glabratus, nitidus, 3.5—5 cm diam.; 8-10-locularis, loculis monospermis; seminibus valde ruminato; calice profunde 4-5-lobato, intus tomentoso, lobis ovatis obtusis, coriaceis, reflexis, 1—1.5 cm diam. Aff. *D. malabaricae* (DESR.) KOSTEL.—Pulau Penang (HANIFF et MD. NUR 3496); Pahang (FOSTON 12865).

129. **D. pubicalix** BAKH., spec. nov.—Folia membranacea, elliptico-oblonga, 6—10 cm longa, 2—4 cm lata, basi rotundata vel subcordata, apice obtusa vel obtuse acuminata, nitida, subtus sparse puberula, glabrescentia; nervis lateralibus utrinsecus 6-8, basalibus ceteris longioribus suboppositis, cum venis subdensis utrinque prominulis; petiolo tereti, puberulo, 0.5—0.75 cm longo. Flores dioici, 4-meri;—masculi breviter cymosi, terni; calice medio lobato, utrinque appresse piloso; corolla hypocrateriforme, medio lobata, utrinque pubescente; staminibus 15, inaequalibus, filamentis subpuberulis, antheris lanceolatis, glabris. Aff. *D. Wrayi* K. et G.—Lower Siam (HAMID C. F. 3827).

130. **D. pubicarpa** RIDL.

131. **D. pulchra** BAKH., spec. nov.—Arbuscula vel frutex; ramulis tomentosis. Folia chartacea, oblongo-lanceolata, 15—35 cm longa, 4—15 cm lata, basi angustata, rotundata vel leviter cordata, apice acuminata, subtus sparse pilosa, dense pellucido-punctata, penninervia; costa leviter prominula; nervis lateralibus utrinsecus 15-17, cum venis utrinque prominulis; petiolo tereti, tomentoso, 0.5—0.7 cm longo. Fructus solitarius, subsessilis, oblongus vel obovoideus, acuminatis, rufo-pilosus, maturitate glabrescens, 4-locularis, 4-spermus, 3.5—6 cm longus, 2.5—3 cm diam.; seminibus albumine aequabile; calice conspicuo, 4-fido, utrinque pubescente, lobis foliaceis, lanceolato-oblongis, basi contractis, apice longiter acute acuminatis, plicatis, nervosis 3.5—8.5 cm longis, 2.5—4 cm latis.—Nova Guinea (MAYR 408).

132. **D. pyrrhocarpa** MIQ.

133. **D. retrofracta** BAKH., spec. nov.—Arbuscula; ramulis glabris. Folia coriacea, oblonga, basi cuneata, apice obtuse acuminata, subtus sparse pilosa glabrescentia; nervis lateralibus utrinsecus 10-15, cum venis densis utrinque prominulis; petiolo semitereti, primo piloso, denique glabrescente, 0.5—1.2 cm longo. Flores dioici, 4-meri;—feminei solitarii, subsessiles; calice utrinque rufo-piloso, 0.5 cm diametro; ovario sericeo, 8-loculare, loculis uniovulatis. Fructus depresso-globosus, maturitate glabrescens, 2.5—3 cm diam.; seminibus albumine ruminato; calice tubo lignoso, lobis reflexis.—Lower Siam (MD. HANIFF et MD. NUR 3984); Perlis (HENDERSON 23013).

134. **D. Ridleyi** BAKH., spec. nov.—Folia coriacea, elliptico-oblonga, 9—20 cm longa, 3—8 cm lata, basi obtusa, apice acuminata, utrinque glabra; nervis lateralibus utrinsecus 6-10, cum venis utrinque prominulis distinctis; petiolo semitereti, glabro, 1—2 cm longo. Fructus sessilis, ovoideo-globosus, nitidus, glaber, 5—8 cm diam.; 8-10-locularis, loculis monospermis; seminibus albumine ruminato; calice lignoso, 4-5-gono, extus tomentoso, intus sericeo, 3—3.5 cm diam. Aff. *D. Whitfordii* MERR.—Johore (RIDLEY).

135. **D. rigida** HIERN.

136. **D. rufa** KING et GAMBLE.

137. **D. Rumphii** BAKH., nom. nov.—*Diospyros utilis* KDS. et VAL.

138. **D. samoënsis** A. GRAY.

139. **D. sarawakana** BAKH., spec. nov.—Folia chartacea, oblonga, 7—17 cm longa, 3.5—7 cm lata, basi cuneata, apice breviter acuminata, utrinque glabra, basi biglandulosa; nervis lateralibus utrinsecus 5-8, supra indistinctis; petiolo semitereti, glabrescente, 1—1.5 cm longo. Flores dioici, 4-meri;—masculi cymosi vel subracemosi; calice profunde lobato, utrinque tomentoso; corolla tubulosa, extus tomentosa, intus glabra; staminibus 14-16, pubescentibus. Aff. *D. styraciformis* K. et G.—Sarawak (HAVILAND 2316).

140. **D. Scortechinii** KING et GAMBLE.

141. **D. selangorensis** BAKH., spec. nov.—Ramuli tomentosi. Folia coriacea, ovato-oblonga, 5—10 cm longa, 1.5—3.5 cm lata, basi subrotundata, apice acuminata, supra nitida, subtus sparse pubescentia; nervis lateralibus utrinsecus 8-10, supra impressis. venis inconspicuis; petiolo tereti, pubescente, 0.3—0.5 cm longo. Fructus solitaribus, subsessilis, ovoideus, rufo-pilosus, maturitate glabrescens, 2—2.5 cm diam.; seminibus 4, albumine aequabile; calice 4-fido, utrinque pubescente; lobis linearioblongis, acutis, ciliatis, 0.75—1 cm longis, 0.2 cm latis. Aff. *D. apiculatae* HIERN.—Selangor (BURKILL et HOLTTUM 8883).

142. **D. setosa** BAKH., spec. nov.—Arbuscula; ramulis mox glabris. Folia tenuiter coriacea, oblonga, 7—15 cm longa, 2.5—4.5 cm lata, basi obtusa, apice acuminata, utrinque glabra; nervis lateralibus utrinsecus 5-7, cum venis supra obscuris; petiolo semitereti, mox glabro, 0.5—1.25 cm longo. Fructus subsessilis, ovoideus, pubescens, 1.25—1.5 cm diam.; tomento cum setis appressis intermixto; calice 4-fido, extus piloso, intus glabro, 0.3—0.35 cm diam., lobis late ovatis obtusis reflexis. Aff. *D. singaporensis* BAKH.—Sarawak (HAVILAND 2324).

143. **D. Siamang** BAKH., spec. nov.—Arbor speciosa. Folia coriacea, elliptico-oblonga, 7—17 cm longa, 3.5—9 cm lata, basi subrotundata, apice acuta vel obtusa, subtus glabrescentia; nervis lateralibus utrinsecus

7-15, supra tenuibus, venis inconspicuis; petiolo semitereti; tomentello, 0.75—1.25 cm longo. Flores dioici, 4-5-meri;—feminei cymosi, 3-5-ni; calice profunde lobato, utrinque tomentoso, lobis ovatis; corolla tubulosa, extus tomentosa, intus glabra; staminodiis 8-10, antheris dorso pubescentibus; ovario subgloboso, sericeo, 8-10-loculare, loculis uniovulatis. Fructus subsessilis, depresso-globosus, apice concavus subtruncatus, sericeus, 3—4 cm diam.; seminibus albumine aequabile; calice tubo incrassato, lobis marginibus dilatatis, inter lobos saccatim confluentibus. Aff. *D. Wallichii* K. et G.—Sumatra (Boschpr. F. 198).

144. **D. siamensis** HOCHR.

145. **D. simaloerensis** BAKH., spec. nov.—Arbor mediocris; ramulis glabrescentibus. Folia tenuiter coriacea, oblonga, 4—15 cm longa, 1.5—4 cm lata, basi obtuse cuneata, apice acuminata, costa excepta utrinque glabra; nervis lateralibus utrinsecus 5-10, venis inconspicuis; petiolo semitereti, glabrescente, 0.2—0.5 cm longo. Flores dioici, 4-meri;—feminei gracile pedunculati; calice 4-fido, intus glabro; lobis orbicularibus, imbricatis, ciliatis, 0.2—0.3 cm diam.; ovario ovoideo, glabro, 4-loculare, loculis uniovulatis. Fructus ovoideus 2—2.5 cm diam.; seminibus albumine aequabile; calice non vel vix accrescente, 0.5 cm diam.—Sumatra, Simaloer (ACHMAD 580, 1343 et 1391).

146. **D. singaporensis** BAKH., spec. nov.—Folia tenuiter coriacea, ovato-oblonga, 6—10 cm longa, 2.5—4 cm lata, basi obtuse cuneata, apice acuminata, costa excepta utrinque glabra, nervis lateralibus utrinsecus 5-10 cum venis utrinque obscure prominulis; petiolo semitereti, glabrescente, 0.5—1 cm longo. Flores dioici, 4-meri;—feminei solitarii, pedunculati, calice 4-fido, extus pubescente, intus glabro; lobis suborbicularibus, ciliatis, 0.2—0.3 cm diam.; corolla tubulosa, extus sericea, intus glabra; staminodiis 4, pubescentibus; ovario ovoideo, subglabro, 4-loculare, loculis uniovulatis.—Singapore (Cult. Bot. Gard.).

147. **D. sogeriensis** BAKH., spec. nov.—Folia tenuiter coriacea, lineari elliptica, 7—20 cm longa, 1.5—6 cm lata, basi obtusa, apice breviter acuminata, supra glabra, subtus primo sericea, denique glabrescentia; nervis lateralibus densis, cum venis utrinque inconspicuis; petiolo semitereti, glabrescente,

0.5—0.7 cm longo. Fructus globosus, maturitate glaber, 4—4.5 cm diam.; seminibus 8, albumine aequabile. Aff. *D. celebicae* BAKH.—Nova Guinea (FORBES 276).

148. **D. soporifera** BAKH., spec. nov.—Arbor mediocris. Folia coriacea, elliptico-oblonga, 30—45 cm longa, 7.5—12.5 cm lata, basi obtusa vel rotundata, apice obtusiuscule acuminata,, utrinque glabra; nervis lateralibus utrinsecus 15-20, utrinque conspicuis, supra plano-depressis; venis reticulatis laxis, utrinque prominulis; petiolo semitereti, glabro, 1.25—2.5 cm longo. Fructus solitarius vel binus, submagnus, ovoideo-globosus, apice depressus, concavus, nitidus, glaber, immaturus 4—5 cm longus, 5—5.5 cm diam., 8-locularis, loculis monospermis; pedunculo 3.5—4.5 cm longo; calice fructifero conspicuo, reflexo, 4-lobo, utrinque glaberrimo, tubo valde incrassato, lignoso, cubiforme, 3.5—5 cm diam., 1—2 cm crasso, lobis crasse coriaceis, basi confluentibus, inter lobos subsaccatis, 1—1.5 cm longis, 2.5—3 cm latis; seminibus elliptico-oblongis, compressis. Aff. *D. mindanaënsis* MERR. —Borneo (BOSCHPR. bb. 17221, ♀).

149. **D. styraciformis** KING et GAMBLE.

150. **D. subrhomboidea** KING et GAMBLE.

151. **D. subtruncata** SCHEFF. ex HOCHR.

152. **D. sumatrana** MIQ.

153. **D. sundaica** BAKH., nom. nov.—*D. pseudo-Ebenum* KDS. et VAL.

154. **D. Toposia** HAM.

155. **D. toposioides** KING et GAMBLE.

156. **D. transitoria** BAKH., spec. nov.—Arbuscula; ramulis glabrescentibus. Folia firmiter coriacea, ovato-oblonga, 4.5—12 cm longa, 1.5—4.5 cm lata, basi obtusa, apice breviter obtuse acuminata, utrinque glabrescentia; nervis lateralibus utrinsecus 7-10, cum venis densis supra inconspicuis; petiolo semitereti, glabrescente, 0.5—1.5 cm longo. Flores dioici;—feminei solitarii, longiter pedunculati; calice profunde 4-5-lobato, intus pubescente, lobis ovatis, acutis, subplicatis; ovario sericeo, 8-10-loculare, loculis uniovulatis. Fructus depresso-globosus, subsericeus, maturitate glabrescens,

2.5—3 cm diam.; seminibus albumine ruminato; calice accrescente, tubo incrassato, 4-5-angulato; lobis marginibus dilatatis, coriaceis, inter lobos saccatim confluentibus, 1.5—2 cm diametro.—Lower Siam (HANIFF et MD. NUR. 4060); Kedah (CURTIS 2626).

157. **D. tristis** KING et GAMBLE.

158. **D. truncata** ZOLL. et MOR.

159. **D. tuberculata** BAKH., spec. nov.—Arbor mediocris; ramulis glabrescentibus, vetustioribus dense verriculoso-lenticellatis. Folia tenuiter coriacea, oblonga, 5—20 cm longa, 2.5—7.5 cm lata, basi cuneata, apice anguste obtuse acuminata, utrinque subglabra; nervis lateralibus utrinsecus 5-8, supra tenuiter impressis, venis supra obscuris; petiolo semitereti, glabrescente, 0.7—2 cm longo. Fructus pedunculatus, ovoideus, glabrescens, 2.5—3 cm diam.; seminibus 1-4, albumine aequabile; calice profunde 4-lobato, intus sericeo, 2—3 cm diametro, lobis ovatis, marginibus dilatatis, coriaceis.—Borneo (AMDJAH 498; CASTRO et MELEGRITO 1409).

160. **D. Ulo** MERR.

161. **D. undulata** WALL. ex G. DON.

162. **D. venenosa** BAKH., spec. nov.—Arbor mediocris; ramulis glabris. Folia tenuiter coriacea, oblongo-lanceolata, 10—30 cm longa, 3—7 cm lata, basi obtuse cuneata, apice acuminata, utrinque glabra; nervis lateralibus utrinsecus 10—15, supra tenuiter prominulis petiolo semitereti, glabro, 1—1.5 cm longo. Fructus solitarius. brevissime pedunculatus, depresso-globosus, pallide sericeus, 8-locularis, 2—3 cm diam.; seminibus 4—8, albumine aequabile; calice plano, 4-5-angulato, utrinque sericeo, 1—2 cm diam., lobis late triangularibus obtusis. Aff. *D. Greshoffianae* KDS.—Celebes (TEYSMANN 12603, 12668).

163. **D. vestita** BAKH., spec. nov.—Arbuscula; ramulis rufo-velutinis. Folia chartacea, elliptico-oblonga, 7—22 cm longa, 2.5—8 cm lata, basi subrotundata, apice breviter obtuse acuminata, subtus rufo-subvelutina, nervis lateralibus utrinsecus 7-15, supra obscuris, impressis, venis inconspicuis; petiolo tereti, velutino, 0.5—0.7 cm longo. Fructus solitarius, subsessilis, ellipsoideus, rufo-hispidus glabrescens,

4-locularis, 1-4-spermus, immaturus 1.5—2 cm diam.; seminibus albumine aequabile; calice 4-lobato, utrinque velutino, 2—2.5 cm diam., tubo incrassato, lobis ovatis, marginibus dilatatis, inter lobos confluentibus. Aff. *D. sumatranae* MIQ.—Pahang (HENDERSON 22290).

164. **D. Wallichii** KING et GAMBLE ex KING.

165. **D. Wrayi** KING et GAMBLE.

166. **D. Yeobi** BAKH., spec. nov.—Folia subdensa, subcoriacea, oblongo-elliptica, 4—9 cm longa, 2—4 cm lata, basi cuneata vel obtusa, apice breviter acuminata, utrinque glabra, nervis venisque utrinque inconspicuis; petiolo semitereti, glabrescente, 0.7—1.25 cm longo. Fructus solitarius, sessilis, globosus, rufo-tomentosus, maturitate glabrescens, 8-10-locularis, 8-10-spermus, 2—3 cm diam.; seminibus albumine aequabile; calice plano, 4-angulato, utrinque tomentoso, 1—1.5 cm diam., lobis late ovatis obtusis, marginibus confluentibus. Aff. *D. rufae* KING et GAMBLE.—Pahang (YEOB 3229).

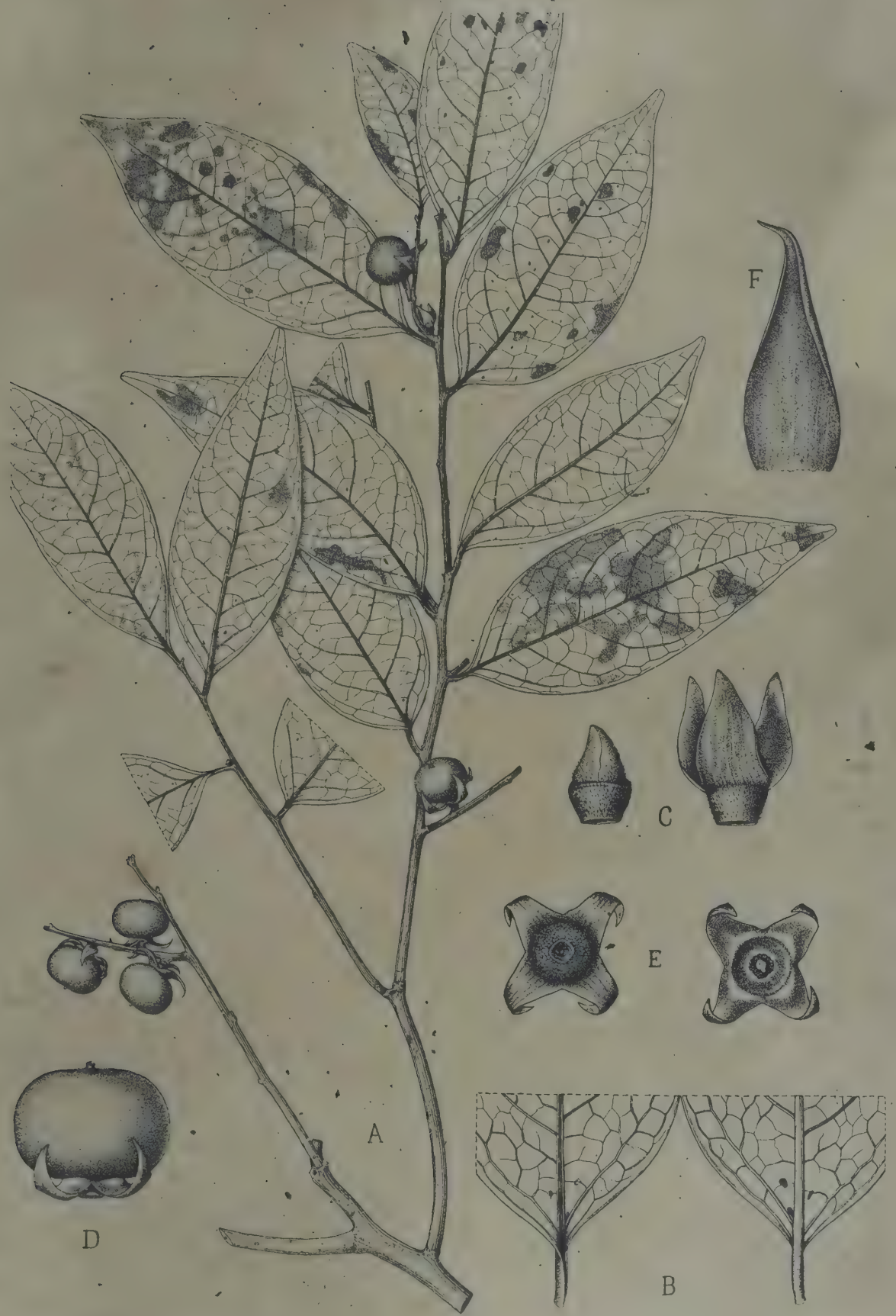
EXPLANATION OF PLATES.

PLATE XLVIII. **Diospyros Holttumii**, BAKH. (type HOLTTUM 15122)—A. Fruiting branch (x ½)—B. Leaf base, seen from above and from below (nat. size)—C. Flower buds, the left one with the calyx lobes removed (x 3)—D. Fruit (x 1½)—E. Fruiting calyx, outside and inside view (x 1½)—F. Calyx lobe from the outside (x 4).

PLATE XLIX. **Diospyros elegantissima**, BAKH. (type RIDLEY 16349)—A. Flowering branch (x ½)—B. Leaf branch (x 2)—C. Leaf base seen from above and from below (x 4)—D. Leaf bud (x 5)—E-L. Flower with details; E. Flower bud (x 4); F. Calyx, seen from the inner side (x 5); G. Calyx lobes, seen from the inner and outer sides (x 10); H. Corolla bud, slit lengthwise, seen from the inner side (x 5); I. Staminode (x 15); K. Ovary (x 10); L. Ovary in transverse section (x 15).

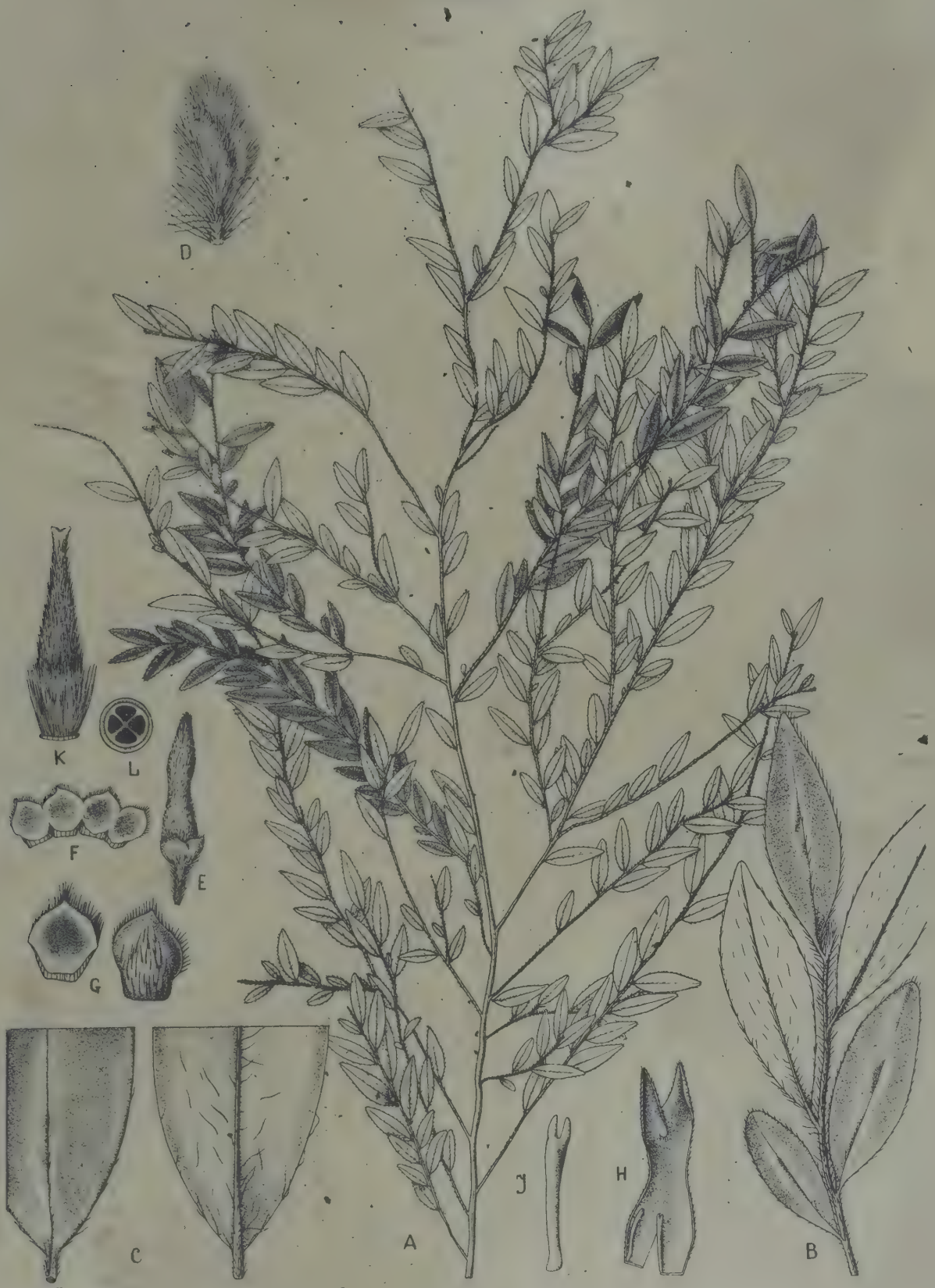
PLATE L. **Diospyros insidiosa**, BAKH. (type HENDERSON 21730)—A. Leaf branch (x ½)—B. Bark (x ½)—C. Leaf base, seen from lower and upper sides (nat. size)—D. Flowering branches (flowers fallen) (x ½)—E. Fruiting branch (x ½)—F. Fruiting calyx from outer and inner sides (x 1½)—G. Fruit cut lengthwise (x ½)—H. Half of fruit in transverse section (x ½)—I. Seeds (x ½)—K. and L. Seeds in transverse section (nat. size).

Plate 48.



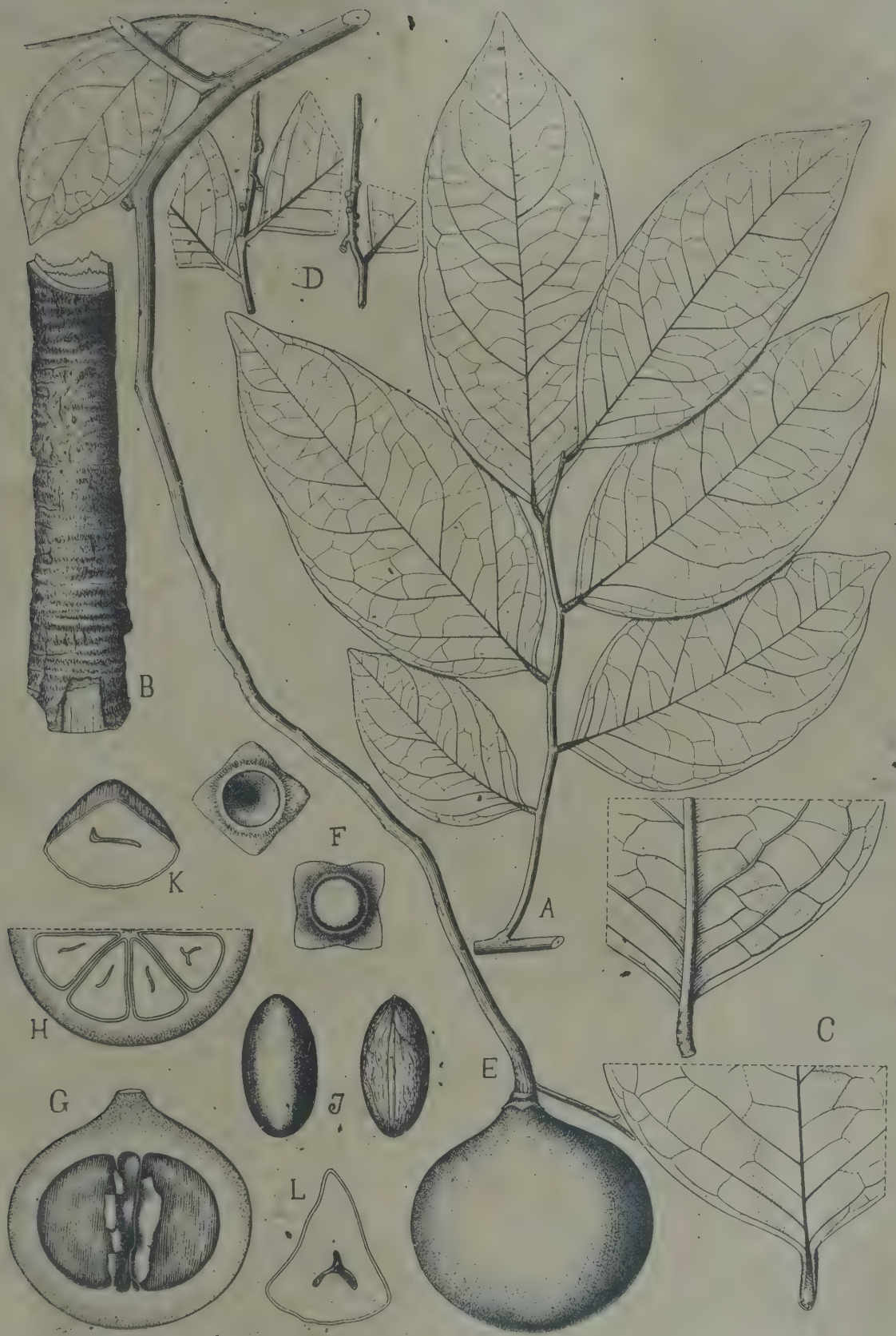
Gard. Bull. S.S. Vol. VII.

Plate 49.



Gard. Bull. S.S. Vol. VII.

Plate 50



Gard. Bull. S.S. Vol. VII.

THE

GARDENS' BULLETIN

STRAITS SETTLEMENTS

Vol. VII 1st June, 1934 Part 3

CONTENTS

	PAGE
The Ferns of Mount Kinabalu, by *Carl Christensen and R. E. Holttum*, with plates 51—62, and 3 text figures	191
Index	317

To be purchased at the Botanic Gardens, Singapore

Price $3.00 or 7/-

SINGAPORE:

PRINTED AT THE GOVERNMENT PRINTING OFFICE, SINGAPORE,
BY W. T. CHERRY, GOVERNMENT PRINTER.

1934

THE

GARDENS' BULLETIN

STRAITS SETTLEMENTS

Vol. VII. 1st June, 1934 Part 3

THE FERNS OF MOUNT KINABALU.

By Carl Christensen and R. E. Holttum.

INTRODUCTION (*R.E.H.*).

The present paper contains an account of all ferns known to have been collected on Mount Kinabalu, with the exception of the latest Clemens collections. The occasion for its preparation is the recent collections made on the mountain by the present writer and by the Clemens expedition (still in the field); these include a large number of previously unrecorded species.

At the time of my visit to Kinabalu, Dr. Carl Christensen had for some time past been intending to work out a critical review of all Bornean ferns, and had examined a large number of type specimens; he had also examined almost all previous Kinabalu collections. He was therefore the person best fitted to deal with the new material, and kindly consented to work over my collections, a complete set of which were sent to him. Subsequently I undertook to sort over the Clemens fern collections, which I named in comparison with my own material; the determination of the Clemens collections of the higher numbers (from 26000 upwards) is therefore due to me, with the exception of some critical specimens referred to Dr. Christensen. The publication of an account of the Clemens collection, which adds a number of species to the total, is made possible by the consent of the Keeper of Botany at the British Museum (Natural History), and of Mr. Clemens, to whom I tender my best thanks.

The greater part of the critical and descriptive section of this paper is due to Dr. Christensen. In some cases, with more ample material for examination, and my observations of the plants in the field, I have added critical notes myself, and four new species are described by me. All such cases bear my name or initials. Any field notes contained in the general list are also written by me, but are not initialled.

In this paper are also described a few ferns collected in other parts of British North Borneo (chiefly in the neighbourhood of Sandakan) by Mr. C. Boden Kloss in 1927. Specimens collected by me at Kudat, and also collections from Sarawak and elsewhere by Dr. E. Mjöberg and others, examined by Dr. Christensen, are in some cases also cited as examples of the species concerned and as records of distribution.

The total number of species, from Kinabalu and its foothills, here enumerated is 417, the new collections accounting for about half of this figure. Of these, 30 are described as new species; in addition, *Asplenium Klossii* from Sandakan is described. The new species and new combinations are indicated in distinctive type in the index at the end of this paper.

Earlier Collections and Literature.

Former fern collections on Kinabalu were made by:

1. Sir Hugh Low 1851 and 1858 (Kew).
2. F. W. Burbidge 1877 (Kew).
3. Dr. C. D. Haviland 1892 (British Museum Natural History and partly Kew).
4. Miss Lilian S. Gibbs 1909 (as the former, mostly very scanty specimens).
5. Mrs. Mary S. Clemens and Mr. Le Roy Topping, October—November 1915 (Herbarium of the Bureau of Science, Manila, Herb. Copeland and duplicates in various herbaria).
6. Some few specimens collected by Haslam 1916, Major C. M. Enriquez 1925 and C. Boden Kloss 1928. (Herb. Singapore).

Most of these collections are dealt with in the following papers which are cited in the present paper by the abbreviations indicated in heavy type:

1. **Baker 1879:** J. G. Baker: Report on a collection of ferns made in the North of Borneo by Mr. F. W. Burbidge.—Journal of Botany *1879* p. 37.
2. **Baker 1894:** J. G. Baker: Filices in *O. Stapf:* On the flora of Mount Kinabalu.—Trans. Linn. Soc. Bot. II. *4:* p. 240–254. Contains a list of the ferns collected by Haviland, determined by Baker, and also references to the specimens collected by Low and Burbidge. The whole list, compiled by Stapf, contains 45 species of ferns, being all those known at that time.
3. **Gepp 1914:** A. Gepp: Filices in *Lilian S. Gibbs:* A contribution to the flora and plant-formations of Mount Kinabalu and the highlands of

British North Borneo.—Journ. Linn. Soc. Bot. *42* p. 195–206.

This also gives a complete list of all ferns known from Kinabalu, the number being now 79, which figure, however, includes some species not collected on the mountain itself.

4. **Copeland 1917:** New species and a new genus of Bornean ferns. Chiefly from the Kinabalu collections of Mrs. Clemens and Mr. Topping.—Philippine Journal of Science *12* C: p. 45–65. This paper contains descriptions of 34 new species.

5. **Copeland Keys:** Keys to the ferns of Borneo.—The Sarawak Museum Journal *2:* p. 286–424. 1917.

The new species described in the former paper are here listed as *nomina nuda* and reference to the other species found by Mrs. Clemens and Topping are to be found but without citations of numbers; these are quoted in the present paper.

In the present paper, items 3, 4 and 5 above, in which the nomenclature of the *Index Filicum* is used, are quoted only in cases where the name of the species has been changed. The two earlier papers, in which the now nearly forgotten nomenclature of *Synopsis Filicum* is used, are more frequently quoted. Frequent reference is made to the *Index Filicum* (1906), where all necessary synonyms and references to literature may be found for the species there listed; a very great many species have been described subsequently, and for these full references to literature are given, even if they are included in the two Supplements to the Index issued in 1913 and 1917.

Topography.

It is not necessary to quote here all references to previous accounts of the topography of Mount Kinabalu. Moulton gave a summary of all expeditions prior to 1914, with references to literature, in the Sarawak Museum Journal Vol. 2 pp. 138–176 (with map). Of these earlier expeditions that of Miss Gibbs is the most important botanically, and Miss Gibbs's account is the most complete description of the general vegetation of the mountain.

The Clemens and Topping expedition of 1916 added a considerable number of species to the known flora of the mountain, but no topographic account was published. No new ground was broken on this expedition.

Mr. C. Boden Kloss, Director of Museums S.S. and F.M.S., made an ascent in 1928, and published a note on the route, with sketch map and altitudes of stopping places (estimated by boiling-point thermometer). Messrs. F. N.

Chasen and H. M. Pendlebury made a prolonged expedition to the mountain in 1930; Mr. Chasen gave a preliminary note on the collecting places, and the two authors subsequently gave a general account of the expedition. The references to these recent accounts are as follows:

C. Boden Kloss: Bull. Raffles Museum no. 5, pp. 1–2.
F. N. Chasen: Ibid. pp. 3–7.
H. M. Pendlebury and *F. N. Chasen:* Journ. F.M.S. Museums XVII: pp. 1–38, pl. I–VIII.

During my visit I followed on the whole the same routes as the previous travellers, as I had not much time for exploration. The present path *via* Dallas and Tenompok instead of Kiau and Lobang gives access to botanically rich areas not visited by previous botanical collectors.

I landed at Usukan, and travelled by bridle path, stopping at *Kota Belud, Kabayau* (600 ft.) and *Koung* (1300 ft.), to *Dallas,* (3200 ft.), where I remained a few days exploring the valleys in that neighbourhood. I then proceeded to *Tenompok* (4700 ft.), where I left the bridle path and ascended to the summit by the usual route of *Lumu-Lumu* (5500 ft.), *Kamborangah* (7200 ft.) and *Pakka* (10200 ft.). On the downward journey I halted at Kamborangah to descend obliquely into the *Kadamaian valley* at a level of about 7000 ft. From Kamborangah I descended to *Lobang* (4000 ft.), where the old cave, which sheltered so many travellers, had recently been blocked by a landslide, and thence down the valley to *Menetendok gorge* (3000 ft.), where I halted to ascend the valley of a tributary (the Kinataki, a much smaller stream than the one of the same name which has its source in Marei Parei ridge). From Menetendok I went on to *Kiau* (on the opposite side of the valley from Dallas) and thence to the *Marei Parei spur* (camp at 5000 ft.) for a short visit. I then returned to Dallas, and finally down the valley again to Kota Belud and Jesselton. The period actually spent collecting on the mountain was from November 4th to 25th, 1931.

The immediate occasion of my visit was an invitation from Mr. J. Clemens, whose long sojourn on the mountain was then just beginning, to go over to get into touch with his expedition. From Mr. and Mrs. Clemens I received much kind hospitality and help, which I gratefully acknowledge. I wish also to express my thanks to the Resident, East Coast (Mr. Maxwell Hall) and to the District Officer at Kota Belud (Mr. G. Robertson) for their generous assistance in connection with my travelling arrangements.

Localities visited by the Clemens expedition and not mentioned above are as follows:

Bungal: between Koung and Kalawat, altitude about 2500 ft.

Dachang: in the Silau basin at about 10000 ft. altitude.

Kalawat: on the hills between Koung and Tuaran (end of the road from Jesselton), altitude about 2500 ft.

Kundasan: on bridle path beyond Tenompok, altitude about 3500 ft.

Masitau 1 & 2: localities in the Silau basin.

Menerintog: beyond Marei Parei, altitude about 5000 ft.

Silau basin: the valley system next beyond Tenompok pass.

Field Notes on Kinabalu Ferns.

The open country round Kota Belud, and the secondary forest on the foothills of Kinabalu, contain almost entirely ferns of wide distribution such as are found also in similar situations throughout the Malayan region. In the open country the common *Gleichenia* spp., *Pteridium, Blechnum orientale, Stenochlaena palustris, Lygodium* spp., *Nephrolepis biserrata* and *N. hirsutula, Cyathea latebrosa, Diplazium esculentum* and *Pityrogramma calomelanos* were all frequent. On the steep banks by the bridle paths, even in the most exposed places, *Blechnum orientale* was particularly abundant, and in the moister places formed a very dense growth. On dry rocky banks *Pteris ensiformis* and *Adiantum caudatum* were occasionally seen. On the shady banks near the streams *Tectaria vasta* was the commonest fern; *Tectaria irregularis* occurred in the most shady places. *Dryopteris urophylla* var. *nitida* was very abundant all along the bridle paths, especially in the shelter of thickets; where it grew in more exposed places among grass its leaves were very yellow. *Sphenomeris chinensis* grew on the banks by the path in not too exposed situations all along from the low country up to at least 4000 ft. *Asplenium nidus, Platycerium, Drynaria* and other epiphytes were occasionally seen, but large trees of sufficient age and suitable bark to carry them were not very abundant.

After passing Kabayau (17 miles from Kota Belud, 600 ft. above sea) the side valleys were much deeper, with steep banks and rocky stream beds, and contained remnants of almost primitive forest. I did not spend much time in this vicinity, but explored one stream for a short distance. On the rocky banks were *Cyclopeltis Presliana* and *Polypodium heterocarpum;* a little higher above the stream were *Cystodium sorbifolium, Tectaria malayensis, Tectaria trifolia,* and *Dryopteris megaphylla.*. Out in the open, in moist grassy places by the path, *Diplazium asperum* was very abundant, and *Tectaria Leuzeana* in more shady spots;

where there was wet open ground by small streams *Dryopteris unita* was frequent, and *Mesochlaena Toppingii* occasional. *Dryopteris contigua* was occasional in drier grassy places. On rocky bank I found *Asplenium squamulatum* and *Cyclophorus varius.*

Beyond Koung the path climbs more steeply. From about 2000 ft. altitude and upwards *Cyathea contaminans* was abundant in the small valleys, often in fine tall groups; *C. latebrosa* also continued frequent. Almost all the country consisted either of clearings for planting rice, or old clearings grown up in various stages of secondary forest. This secondary forest, consisting of a rather small number of tree species, is felled and burnt in patches for rice cultivation. *Pteridium* survives the burning, and to some extent also *Cibotium;* they are the two most abundant ferns on the drier slopes in the secondary forest. The young leaves of *Pteridium* have to be weeded out of the rice fields. I saw one burnt patch which had not been planted with rice; against the black burnt ground the very numerous pale green young *Pteridium* leaves showed up strongly and constituted almost the only vegetation. *Gleichenia* seems to be quite killed by burning. The *Cibotium* is locally very abundant and the largest plants are enormous, the fronds 4 or 5 metres high, the stock short and decumbent. On the steep shaded valley sides, near the streams, at 2000–3000 ft., *Tectaria pleiosora* is very abundant, its leaves rather thick and fleshy in texture, the pinnæ very broad. Unfortunately at the time of my visit hardly any fertile fronds were to be seen. *Diplazium vestitum* v. *borneense, Pteris excelsa,* and *Coniogramme macrophylla* are also characteristic of similar situations at about this level.

I visited the bottom of the valley immediately below Dallas, and there found a much richer riverside flora, comparable with that of the main Kadamaian stream above Menetendok, which I will describe later. The stream was almost completely overshadowed by trees up to 50 ft. high, among them a remarkable Meliacea with pinnate leaves 2 m. long and pendulous inflorescences 3 m. long. On the moist rocks and on trees near the stream were *Asplenium borneense, A. spathulinum, A. filiceps, Antrophyum callifolium, Polypodium Emersoni, P. insigne, P. ithycarpum, Loxogramme ensifrons, L. involuta v. gigas,* and a sterile *Nephrolepis.* Where there was a rather more open valley bottom, and wet black soil, there grew a most remarkable tall *Pteris* which Dr. Christensen has called *P. Holttumii.* This has a very stout wide-creeping rhizome a few centimetres below the soil surface. The rather distant tall erect fronds are not unlike the leafy shoots of some members of

the Zingiberaceæ, and might easily be overlooked. I did not see it at any other place.

The bridle path onwards from Dallas climbs slowly. Above it on the right rises the Dallas-Tenompok ridge, and in this ridge several small rocky valleys in primitive forest have an interesting and characteristic flora at about 3500 ft. Here I found some plants also abundant at Tenompok, but on the whole the floras of the two localities were distinct. Probably the most abundant ferns on wet rocks by the streams were *Polypodium papillosum* and *Asplenium filipes;* these grow only on constantly wet rocks, usually by small waterfalls. In more open places, the stream-bed rocks had plants of *Dryopteris mirabilis, D. firmula, Campium subsimplex, Trichomanes maximum, Coniogramme fraxinea,* and *Lomagramma Brooksii.* The last-named species, like all of its genus which I have seen, starts life creeping over the stream-bed rocks, the rhizome at this stage quite slender, the fronds suberect and the pinnæ rather small; such creeping rhizomes wander on until they meet a tree, up which they may climb. The climbing rhizome rapidly develops to a much larger size, and bears fronds of full mature size growing out horizontally from the tree. Only such climbing plants bear fertile fronds, and the mature form of the fern is never seen in the creeping stages. Fertile fronds of *Lomagramma,* like those of most species of *Teratophyllum,* are rarely found, and are perhaps dependent on an exceptionally dry season, or exposure due to the fall of a neighbouring tree. On the ground in the forest one of the commonest ferns was *Diplazium cordifolium,* the typical form and also var. *pariens.* Others were *Heterogonium profereoides, Dryopteris aciculata, Lindsaya tenera, Microlepsia Hookerae, Diplazium fraxinifolium* var. *grossum* and *Dryopteris crassifolia. Lindsaya repens* Bedd. was rather frequent on the lower parts of tree trunks in moist situations, its finely dissected bathyphylls sometimes very conspicuous.

Somewhat further on, on the forest edge, were three remarkable ferns which I did not find elsewhere. On the grassy bank of the path were *Dryopteris multiseta* and *Dennstaedtia rufidula,* the one very scaly, and the other even more densely hairy; and actually in the thicket of the forest edge was *Dennstaedtia cuneata.* The last-named grew to an enormous size, the erect fronds 4 m. high, a fresh pale green, rising from a very thick creeping rhizome. Also in the edge of the forest were enormous plants of *Tectaria Leuzeana.*

At Tenompok, 4700 ft., I explored the forest fairly thoroughly for terrestrial ferns and low epiphytes, but probably missed some of the epiphytes from the upper tree

branches. The low-level epiphytes (*i.e.*, those near the ground level in the forest) were : *Leucostegia hymenophylloides, Asplenium scolopendrioides, A. acutiusculum, Polypodium Reinwardtii, Trichomanes bipunctatum, Hymenophyllum eximium, H. thuidium,* and *Monogramma trichoidea.* The high level epiphytes were: *Polypodium albidosquamatum, P. rajaense, P. pallens, P. incurvatum, Loxogramme ensifrons, L. nidiformis, Cyclophorus borneensis, Hymendepis revoluta, Humata kinabaluensis, Asplenium pachychlamys, Elaphoglossum petiolatum, E. callifolium, Davallia embolostegia,* and *Vittaria zosterifolia.* A single felled tree had on it nine species of epiphytic ferns, besides orchids and *Aeschynanthus* sp.

The terrestrial fern flora at Tenompok may be divided into the following sections: ferns of the open (beside the bridle path), and ferns of the forest, the latter being again divided into streamside ferns and others. These divisions are not quite sharp, as some ferns tend to grow just in the edge of the forest. The streams at Tenompok were all small, steep and rocky, completely shaded by forest, and the fern flora of the larger open streams, as seen at Lobang, did not appear, except that some species which would normally grow on the banks of larger streams found suitable positions on the earth banks of the bridle paths.

Ferns of open places were first the Gleichenias, *G. linearis* in one or more varieties, and *G. Norrisii. G. Norrisii,* here as in the Peninsula, is a fern of the edges and clearings in rather high forest, not of exposed ridge-tops; in the Peninsula it occurs at mid-elevations in the hills, at about 2000 ft., and presumably it is not actual altitude or temperature so much as the rather humid and half-shaded situation that is the determining factor in its case. It is evidently a fern of rather narrow limits of toleration, perhaps on the part of the gametophyte. Other ferns of open places were *Hypolepis Brooksiae* and *Histiopteris stipulacea.* On the bank just in the shade of the forest edge were *Dryopteris cuspidata, Diplazium poiense, Asplenium porphyrorachis* and *Polystichum gemmiparum;* in rather wet places especially *Microlepia manilensis* was abundant.

Ferns of the forest shade were the remarkable *Angiopteris ferox* (rather small for the genus, abundant), *Dryopteris baramensis* (abundant), *Diplazium barbatum* (abundant), *Dryopteris sparsa, D. gracilescens, D. heterocarpa, D. Toppingii, D. multisora, Dennstaedtia ampla, Cyathea latebrosa, C. recommutata, C. tripinnata* (on forest edge), *Pteris purpureorachis, Lindsaya crispa,* and *Asplenium normale.* By the streams in the forest were: *Asplenium filipes, Dryopteris tenompokensis* (on rocks, with

erect fertile fronds), *D. hirtipes* (abundant), *Marattia pellucida, Trichomanes apiifolium, T. cupressiodes, Lindsaya malayensis,* and *Tectaria crenata.* By the streams were also abundant as low-level epiphytes *Asplenium scolopendrioiodes* and *Leucostegia hymenophylloides,* the latter with much larger leaves than when growing in more exposed places.

The ridge of the mountain climbs little between Tenompok and Lumu Lumu, with ups and downs; on the higher steeper parts the forest is dwarfed and open, but less so than beyond Lumu Lumu. On the steeper parts *Plagiogyria adnata* was the characteristic terrestrial fern; for a note on this species and its relation to *P. Clemensiae* see the systematic section. Species of Plagiogyria seem always to be ferns of dwarf forest on high mountain ridges. Of terrestrial ferns of higher forest on less steep ground I collected the following: *Diplazium atrosquamosum* (abundant just above Tenompok), *Dryopteris multisora* (occasional all along), *D. baramensis, D. crassifolia, Diplazium speciosum, Microlepia Hookeriana,* and *Polystichum carvifolium* (?). On the higher ridges grew *Blechnum vestitum* and a variety of *Gleichenia linearis* with short broad branches, glaucous beneath.

Where the forest was fairly tall, all the smaller vegetation was hung with trailing mosses and liverworts, and all tree trunks were covered with moss. On the ridge-tops, where the forest was much lower, the trees were more thickly covered with moss-cushions, but less of the pendulous mosses; on the ground also were cushions of mosses and liverworts. The trees were laden with epiphytic orchids, and a smaller quantity of ferns. Of the ferns, the climbing species *Lindsaya repens* and *L. pectinata* were the most abundant. Probably next in abundance was *Polypodium consociatum,* growing among the mosses. Other epiphytes were: *Polypodium Curtisii* (abundant near Tenompok), *P. lancifolium, P. albidosquamatum, P. rajaense, Vittaria angustifolia, Hymenophyllum eximium, H. Neesii, H. pachydermicum, Trichomanes proliferum* and *T. pallidum.*

Small Cyathea plants were frequent, but I did not see any mature tree ferns except a magnificent *Dicksonia Blumei,* with very stout trunk and long red-brown hairs all over stipe and rachis. At Lumu Lumu, in wet ground by a small stream, were plants of *Cyathea capitata,* the largest with a stem 30 cm. high; it is one of the largest simply pinnate species.

Beyond Lumu Lumu the spur of the mountain ascends more steeply, but always there are alternations of narrow exposed ridges with small trees, and broadly rounded parts

of the spur carrying rather high forest. In the latter, a locally abundant terrestrial fern was *Polystichum carvifolium* (?); *Dryopteris crassifolia* also occurred. Terrestrial ferns were abundant in the more open forest on the steep ridges. These included several species of Gleichenia: *G. linearis, G. longissima, G. bullata, G. hirta* (very scaly), and *G. microphylla* var. *semivestita.* In exposed places at above 8000 ft. occurred also *G. borneensis. G. bullata* extended up the mountain to the limit of tree growth, much dwarfed at the highest altitudes. Other terrestrial ferns were *Lindsaya diplosora, Dryopteris viscosa* and *D. supravillosa, Plagiogyria, Blechnum vestitum,* and on steep banks locally *Cheiropleuria bicuspis,* mostly very small with stiffly coriaceous leaves and long creeping rhizomes.

Two tree ferns were fairly abundant at the 6000–7000 ft. level, *Cyathea ramispina* and *C. kemberangana,* the former particularly conspicuous with its much-branched "aphlebiæ" at the bases of the stipes. These aphlebiæ are at first green, but turn brown before the leaf has ceased to function; they persist on the old leaf-bases and form a complete covering for the trunk of the fern. The youngest plants lack the aphlebiæ, but could readily be recognised by their black stipes. The limited but dense covering of pale scales at the base of the stipes of *C. kemberangana* was also characteristic. *Dryopteris subarborea* also occurred, its leaves equalling in size those of small Cyatheas.

Of epiphytes the following were collected. *Polypodium consociatum* occurred abundantly almost up to Kamborangah, and locally *P. clavifer;* other small species were *P. bryophyllum, P. mollicomum, P. streptophyllum, Scleroglossum* spp., *Hymenophyllum pilosissimum, H. microchilum, Trichomanes palmatifidum* and *T. album.* Larger epiphytes, on the higher or more exposed tree-branches were: *Polypodium albidopaleatum, P. stenopteris, Elaphoglassum Beccarianum* and *E. decurrens.*

From Kamborangah (7200 ft.) I made a descent obliquely into the Kadamaian valley, reaching the stream at a level slightly below that of the camp. As one leaves the crest of the ridge, the dwarfed forest gives place to higher trees, with an undergrowth of fine bamboo. In this lower parts of trees and fallen logs are covered with masses of liverworts, and sometimes on large trees are great cushions of liverworts at intervals on the trunks. Lower down were a fair quantity of Dicranaceous moss cushions on the ground and on fallen logs, but always mostly liverworts. The forest was not very densely shady, and had a rather open undergrowth of bamboo, rattans, and some ferns. The common fern was *Polystichum carvifolium* (?), and also abundant were *Dryopteris viscosa,*

D. multisora, Plagiogyria Clemensiae, Acrophorus Blumei. Less frequent were *Blechnum vestitum* (never abundant nor large except near the ridge top), *Plagiogyria glauca* (sterile), and *Diplazium cordifolium.*

Near small streams the fern flora was richer. *Pteris flava* was quite abundant and often large, but not often fertile. Other ferns abundant in this situation were *Diplazium tricholepis, Athyrium macrocarpum, Trichomanes maximum;* also occasionally *Blechnum Patersoni, B. Finlaysonianum* and *Cyathea capitata.* Of large tree ferns *Cyathea Korthalsii* and *Dicksonia Blumei* were noted; on the former were some very large plants of *Spiridens Reinwardtii* growing epiphytically half way up the trunk. *Blechnum Finlaysonianum* is a low country fern in the Malay Peninsula, and I was surprised to find it at so high an altitude.

On approaching the main stream the forest became much richer in ferns and all the trees were loaded with pendulous bryophytes. Of terrestrial ferns I found the following: *Dryopteris baramensis, D. megaphylla, D. stegnogramme, Polystichum obtusum* (sometimes as an epiphyte), *Athyrium amoenum.* On the forest edge, by the river, was a fern thicket containing *Hypolepis tenuifolia, Dryopteris subarborea, D. megaphylla,* and other large species. On the rocks by the stream were a pretty pink balsam *(Impatiens Havilandii), Blechnum Patersonii,* and *Polypodium dolichosorum* (with erect fronds). In the forest beyond the stream were some very large plants of *Angiopteris.* Epiphytic ferns on trees near the river were *Polypodium calcipunctatum* (very large), *P. celebicum, P. venulosum,* and *Asplenium tenerum.*

At Kamborangah the forest is dwarfed, with much undergrowth of Gleichenia and Nepenthes *(N. Lowii).* Above it the ridge broadens out, and for some distance carries a much taller mixed forest, with bamboo undergrowth, like that encountered on the way to the valley below Kamborangah. Higher up, the ridge-top becomes narrower again, and the small trees carry many small epiphytic ferns, including a number of Grammitis spp. (*Polypodium Hieronymusii, P. fasciatum, P. Havilandii. P. calcipunctatum* and *P. kinabaluense*) and also Hymenophyllaceæ. Throughout this forest, in the wetter places, occur *Plagiogyria Clemensiae, Dryopteris viscosa,* and occasionally *Athyrium Moultonii.*

In a few places there are clearings (one, on a prominent ridge-end, seemed fairly clearly to have been burnt) carrying only low vegetation. In these places small ferns were very abundant, a very dwarf Dipteris forming locally

a pure growth, or mixed with *Gleichenia borneensis*. In wetter places *Paesia radula* also occurred.

There is a more or less gradual transition to a more open type of ridge forest, consisting almost entirely of *Leptospermum* spp. and conifers (*Dacrydium* predominating) at first chiefly with an undergrowth of Gahnia and plants of similar habit, with few bryophytes or ferns, either terrestrial or epiphytic. In clearings, trailing Lycopodium spp. are very abundant, also Gleichenia spp. and Dipteris. Somewhat above 9000 ft. *Cyathea Havilandii* and *Nepenthes villosa* become very abundant in this Dacrydium-Leptospermum forest, forming the bulk of the undergrowth, the Cyathea with almost erect fronds and no trunk showing above ground level. The Nepenthes trails along the ground, and rarely climbs. *Schizaea fistulosa* also occurs here. Mosses of the genus Macromitrium were occasional epiphytes, but many of the trees bore none.

On reaching about 10000 ft. the track leaves the crest of the ridge and descends a little into the valley to the stream at Pakka. The valley forest is notably wetter than that of the ridge top, and becomes at once mossy; by the stream itself all trees were loaded with bryophytes, chiefly (as at almost all places) liverworts. The ground vegetation of this valley forest consists largely of a tall-leaved orchid, *Eria grandis*. There were also some fine ferns, including the large species *Polystichum Holttumii* and *Dryopteris paleacea*, the very finely dissected *Athyrium pulcherrimum* and *Acrophorus Blumei*, and as usual *Plagiogyria Clemensiae* and *Dryopteris viscosa*.

Of epiphytes I found *Hymenophyllum australe*, *Asplenium Elmeri*, *Loxogramme parallela*, *Polypodium monocarpum*, *P. pakkaense*, *P. sumatranum*, *P. cucullatum* v. *subgracillimum* and *Elaphoglossum angulatum*.

The stream is very steep and rocky. In an open place, among a mass of liverworts which covered the rocks beside the stream, *Hymenophyllum paniculiflorum* grew abundantly. On a shaded vertical rock was a large quantity of *Trichomanes Teysmannii* and *Hymenophyllum serrulatum*. On a few of the rocks, above flood level, were small Grammitis plants, and *Athyrium macrocarpum*.

A short climb above Pakka brings one to the edge of the continuous forest. After that is scrub or small patches of forest at intervals, separated by bare sloping rocks, the patches of vegetation becoming smaller and the bare rocks more extensive until finally there is nothing but rock. In this bare sloping rock are many crevices in which plants grow; the crevices are the drainage channels. Occasionally there is a hollow containing a pool of water. The Leptospermum which is the most abundant tree in much of the

forest about Pakka grows in these crevices, at the higher altitudes dwarfed to only a few inches high. With it are a few other woody plants, and a number of herbs and grasses, as described by Miss Gibbs. The small ferns of the summit region do not usually grow in these exposed crevices, which is doubtless why Miss Gibbs overlooked them. They occur only where an overhanging rock affords shelter from insolation, and usually near a trickle of water. The most abundant is *Polypodium kinabaluense,* and near the summit I found *Oreogrammitis Clemensiae.* Other ferns found in similar situations were: *Asplenium malayo-alpinum, Athyrium Clemensiae, Polystichum kinabaluense, Polypodium caespitosum.* In the undergrowth of one of the last thickets were *Dryopteris adnata* and *Hymenolepis squamata* var. *borneensis,* the latter with erect fronds. Two interesting ferns of the summit region, not found by me, are *Stenolepia tristis* and *Blechnum fluviatile.*

On the descent of the mountain, I followed the same path as far as Kamborangah, descending thence to Lobang, the route taken by Miss Gibbs for both ascent and descent. The drop of about 3000 feet, down the side of the main spur of the mountain, is a very steep one, and in many places the ground is so steep and rocky as to carry no large trees. Not far below Kamborangah *Monachosorum subdigitatum,* a fern not previously seen, was found in small quantity, terrestrial in a rocky place. Of epiphytes, I found the very large *Humata kinabaluensis* var. *subvestita, Polypodium subauriculatum,* and *P. subminutum.* In the lower part of the descent, on rocky ground, *Asplenium lobangense* was the commonest fern; in the more open places *Tectaria Leuzeana* and *Dryopteris megaphylla* also occurred.

At the bottom of the descent two streams were crossed. On the rocks by the streams, just above flood level, the graceful little *Adiantum diaphanum* was very abundant. Also on the rocks *Dryopteris hirtipes* was frequent, as at Tenompok. Terrestrial in the neighbouring forest were *Pteris Grevilleana,* the very large *Angiopteris Holttumii,* and *Lomagramma Brooksii* (on rocks and trees).

I ascended one of small streams for a little distance, and then descended to the main Kadamaian river in the valley bottom, following it as far as the Menetendok gorge. The small stream was very steep and rocky. On its rocks were some of the same ferns found at Tenompok, and also *Diplazium pallidum* and *Athyrium silvaticum.* Beside the stream was a very tall *Cyathea contaminans,* unusually slender and the stipes hardly muricate; the rather shady and very moist conditions were perhaps the cause of its peculiar character. In the forest near the stream, and again

lower down by the main river, were a few plants of *Botrychium daucifolium.*

The descent from Lobang camp to the Kadamaian river was through fairly high forest. The ground was still fairly steep and rocky, and we passed another small stream. There were a considerable number of terrestrial ferns and a rather rich ground vegetation generally. Among the ferns were *Microlepia strigosa, Tectaria vasta* (abundant throughout), *Polystichum gemmiparum* and *P. aristatum, Diplazium tabacinum, D. fraxinifolium,* D. sp. near *Woodii* (no. 25579), and *Dryopteris sparsa.* Near the stream *Lomagramma Brooksii* was very abundant creeping over the rocks and climbing some of the trees, but no fertile fronds were seen. *Hymenophyllum pachydermicum* was abundant on some tree trunks.

The trees and rocks beside the river bore a large number of ferns. A contrary statement is made by Miss Gibbs, who perhaps crossed the river below the limit of high forest, missing the most interesting part of its course. On one tree were the following species: *Asplenium tenerum, A. spathulinum, A. filiceps, Davallodes Burbidgei, Polypodium ithycarpum, P. sarawakense, Cyclophorus borneensis,* and several orchids. *Davallodes Burbidgei* was frequent on the trees, while *D. borneensis* was more abundant on rocks and rarely grew epiphytically. Other ferns growing on rocks were: *Polypodium commutatum, Tectaria Holttumii, Dryopteris dissecta, D. subpubescens,* and *Polypodium heracleum.* On small rocks by the river's edge, where it would be frequently subject to flooding, grew *Diplazium grammitoides,* in stature, habit and habitat agreeing closely with *Dryopteris calcarata v. ciliata* in the Malay Peninsula.

Passing through the short Menetendok gorge, with almost sheer walls of rock estimated at 300 feet high, we again reached cultivated ground. High up, the rocks were covered with pendulous fronds of *Nephrolepis barbata.* In the secondary growth round about was much Laportea, which made exploration difficult. The Kinataki, a small tributary of the Kadamaian, joins the main stream just below the gorge, and in its lower part were few ferns of interest. Further upstream, in higher forest, conditions were more favourable for ferns, and the epiphytic species common by the main stream were found. The stream being narrower than the Kadamaian, conditions were more sheltered. The *Diplazium grammitoides* was absent, but *Adiantum diaphanum* common all along on the rocks, and locally *Diplaziopsis javanica* and *Campium quoyanum.* The smaller trees were covered with pendulous liverworts. On the sloping ground above the stream, in the forest, *Heterogonium profereoides* and *Tectaria pleiosora* were frequent,

the latter always sterile; also present were *Tectaria vasta, T. Leuzeana* and *Dryopteris microthecia.* Angiopteris plants of large size were occasional; I did not attempt to collect them all, but took specimens of *A. angustifolia. Tectaria coadunata* was once seen, pendulous, on a vertical mossy rock over the stream. At the furthest point reached, in a wet shady place in high forest near the stream grew *Didymochlaena truncatula* and *Coniogramme macrophylla.*

Returning by a path at a higher level, leading partly through well-grown secondary forest, I found *Dryopteris urophylla v. nitida* as a very abundant terrestrial fern, locally forming a continuous undergrowth.

The open country between Menetendok and Kiau yielded few ferns. Beside the rice fields *Pteris biaurita* was common, also *Pityrogramma calomelanos* (not seen higher up on the mountain) and the usual ferns such as *Nephrolepis biserrata* which are characteristic of open places. The only epiphytes noted were *Polypodium subauriculatum* and *Cyclophorus borneensis.*

From Kiau I went to the Marei Parei spur. The path leads round the shoulder of the Gurulau spur, on the slopes of which Kiau stands, through secondary growth and clearings, and down to the Kenokok river. From there to the Dahombang river is a fairly good forest growth, on fairly level ground, with herbaceous undergrowth containing many of the ferns seen near Dallas and Tenompok. The Heterogonium was frequently seen, and Lomagramma in rocky places. Where the path descended a little to the Dahombang river, the fern flora became more luxuriant. *Asplenium borneense* was very frequent and large, climbing on the rocks. On small trees near the river a pendulous Selaginella was epiphytic, with many bryophytes. The stream bed itself was quite bare of all plant life, owing to a large landslide in the headwaters of the stream not long previously; the earth and stones, borne down by the flood, had scoured the boulders of the river bed perfectly clean, and it bore a very different appearance from that of the Kadamaian.

From the Dahombang the path climbs first up the slopes of the Penibukan ridge, where *Pteris rangiferina* and *Cyathea longpipes* were the most interesting ferns, both occurring on the crest of the ridge. The path descends a little to cross the Kinataki (not the stream of the same name which flows into the Kadamaian), and then climbs the Marei Parei spur. The ridge forest continues for a time much as on the Penibukan ridge, but gradually the trees become shorter and more mossy, and conifers more numerous. In the clearing on the ridge where we camped were some interesting ferns. In wet ground, in fully

exposed places, grew *Dryopteris lithophylla,* its young fronds covered with mucilage, and in moist rock crevices, also fully exopsed, was *Schizoloma Jamesonoides,* with bright red young leaves. In the edge of the neighbouring thickets was *Matonia Foxworthyi,* which I did not find on the main spur of the mountain.

Above the camp site at Marei Parei (5000 ft.) the ridge rises steeply for some little distance, the ground being rocky and covered with low flat-topped trees of Leptospermum and bushes of other species, or open and covered with Cyperaceæ; in the wetter places were some plants of *Nepenthes rajah.* At the top of this steep rise a low mossy forest begins, consisting of close-growing slender trees thinly draped with liverworts. The ground vegetation was poor, containing a slender rattan and also some of the ferns found lower down the ridge, with *Diplazium Hewittii* in addition. No Plagiogyria nor *Dryopteris viscosa,* character plants of the main spur at about this altitude, were seen. *Nepenthes villosa,* long climbing plants, was abundant. The tree growth consisted of many species, including several species of Podocarpus and Dacrydium. Epiphytes were few, the only fern noted being *Scleroglossum debile.*

Rather suddenly the ridge broadens out, as it does above Kamborangah, and carries a forest of quite tall trees, with bamboo undergrowth. The ground was rocky, and conditions evidently very humid, though no stream appeared to be near. The trees were loaded with pendulous bryophytes. *Trichomanes maximum* and *Monachosorum subdigitatum* were abundant as terrestrial ferns, others being *Diplazium speciosum, D. cordifolium, Pteris kinabaluensis, Dryopteris multisora* and *D. stipellata.* A little further up, *Dryopteris viscosa* became abundant, often with quite tall stems like miniature tree ferns, and also *Polystichum carvifolim* as near Kamborangah, the Trichomanes and Monachosorum gradually disappearing. There were also a few plants of *Acrophorus Blumei* and *Blechnum Patersoni.* The ground became steeper and the forest smaller, and I found a few sterile plants of *Blechnum Fraseri* with erect slender stems up to a metre high. Several epiphytic ferns characteristic of Tenompok and Lumu Lumu were seen, and also *Asplenium nigrescens.*

The steep ridge higher up bore small very mossy forest much as that near Kamborangah under similar conditions (the "moss" always consisting chiefly of liverworts), *Dryopteris viscosa* being always the common ground fern, with Plagiogyria, *Athryium macrocarpum* (small), and in rocky places Cheiropleuria, large and typical, not small and coriaceous as near Kamborangah. Gleichenia spp. occurred all along, and small plants of *Cyathea ramispina.*

PHYTOGEOGRAPHICAL NOTE (C. CHR.).

The number of species known only from Kinabalu is rather large, but this does not mean that all of them are endemic there; on the contrary, I think it probable that many of them occur also on the mountains in other parts of Borneo, especially in the mountainous region on the boundary between Sarawak and Dutch Borneo. Dr. E. Mjoberg's collections from Mt. Tibang and Mt. Murud contain several species known previously from Kinabalu only. Considering further that several species among the additions to the Kinabalu flora recorded in this paper have previously been known only in Sarawak, I conclude that the number of species really endemic is not very large.

The fern flora of Kinabalu (and of Borneo as a whole) is intimately related to that of the Malay Peninsula and Sumatra, and in a somewhat lesser degree to that of the Philippines, especially the island of Mindanao. It is not so nearly related to that of Java, and still more remote from that of New Guinea, though the two big islands have a number of species in common.

Among the most interesting records of increased distribution contained in this paper are the following: *Blechnum fluviatile*, known previously from Australia and New Zealand; *Stenolepia tristis*, known previously only from the mountains of Java; *Paesia radula*, previously only known from Sumatra, now reported from Kinabalu and also from Celebes; *Heterogonium profereoides*, previously known only from Mindanao.

Of the above, *Blechnum fluviatile* is a notable addition to the list of species which form a south-temperate element in the Malayan fern-flora, others on Kinabalu being *Schizaea fistulosa*, the two species of *Eugleichenia*, *Pteridium esculentum*, and the remaining species of *Blechnum*, section *Lomaria*.

ENUMERATION OF THE SPECIES.

Our ideas of the natural relationship of the tribes and genera of ferns have considerably changed since the year 1900, when Prof. Diels published his scheme of classification (*Die Natürl. Pflanzenfamilien* 1, 4), which I followed in my *Index Filicum,* but we still lack a general treatise in which a new and more natural system is worked out. The only work of this kind in recent years is Dr. E. B. Copeland's interesting paper: The Oriental Genera of Polypodiaceæ[1], in which he gives many valuable contributions to the right conception of a natural, phylogenetic classification of ferns, but unfortunately he deals with the Asiatic genera only. I agree with him on the whole in regard to his ideas of the mutual relationships of these genera, less so in his delimitation of the individual genera. In this paper I have consequently arranged the genera in a manner which corresponds in many respects with Copeland's ideas, but have maintained most genera as defined in my Index, chiefly because I do not desire here to create a considerable number of new combinations. (C. Chr.).

OPHIOGLOSSACEÆ.

OPHIOGLOSSUM Linnaeus.

O. pedunculosum Desv.—Kiau (Cl. 10093, Tp. 1636), near Dallas (H. 25269, Cl. 27415, 26158), Silau basin, 7000 ft. (Cl. 29280).

On bare ground in open places; often brought in by the Dusuns, but not often seen by me.

O. reticulatum L.—t. Copeland, *Keys* 299, not seen.

O. intermedium Hook.—Kiau (Cl. 10243).

O. pendulum L.—Tenompok (Cl., s.n.).

O. Moultoni Copel Journ. Straits Br. R. Asiatic Soc. no. 63, 72 (1912).—Tenompok (Cl. 24768, 28320).

The largest fronds of these collections agree with the description of the species; others are shorter and narrower, but of the same general shape. Some however seem to grade into more typical *O. pendulum,* and I think that more field study is needed before the status of the species can be decided. (R.E.H.).

BOTRYCHIUM Swartz.

B. daucifolium Wall.—Gurulau Spur (Tp. 1840), near Menetendok (H. 25578), Tenompok (Cl. 29210, 27982), Below Dachang (Cl. 29049).

In rich soil in shady valley forest, near streams.

(1) University of California Publications in Botany, 16, no. 1. 1929.

HELMINTHOSTACHYS Kaulfuss.

H. zeylanica (L.) Hk.—Low damp woods, 1000 ft. (Cl. 27666).

MARATTIACEÆ.

ANGIOPTERIS Hoffmann.

A. angustifolia Presl.—Menetendok (H. 25716). New to Borneo.

A. ferox Copeland, Phil Journ. Sci. 6C: 134. 1911.—Dahombang (Haviland 1476), Tenompok, abundant in forest (H. 25382).

A peculiar species, known previously from Mt. Penrissen, Sarawak; the black-brown stipes and rachises are densely bearded with blackish, linear scales.

A. Holttumii C. Chr. n. sp.—Maxima, 4 m. alta, pinnis fere 1 m. longis pinnulis ca. 35-jugis, subcontiguis, subsessilibus (petiolis vix 8 mm. longis, alatis), linearibus vel oblanceolatis, 15 cm. longis, 2.5 cm. latis, basi subequaliter truncatis, in apicem brevem acuminatum grosse serratum sat subito angustatis, marginibus irregulariter et leviter dentatis. Venulis recurrentibus distinctis, ultra medium vel fere ad costam productis. Soris 1.5–2 mm. a margine remotis, sporangiis 5–7-jugis. Textura herbacea, colore superne obscuro inferne pallidiore, costis costulisque subtus paleis parvis persparse onustis.

Kinabalu: Lobang (H. 25552, type in Herb. C. Chr.), Kiau (Clemens 10234).

A mighty fern, nearest *A. arthrocarpa* v.A.v.R. Bull. Jard. Bot. Buit. III Ser. 5: 183, but pinnules sessile; the Bornean *A. muricata* Pr. is nearly as large, but the recurrent vein indistinct or none.

A. Brooksii Copel. Phil. Journ. Sci. 10C: 145, t.1. 1915.—Dallas-Tenompok ridge, in ravine (Cl. 26825, 27354).

Known previously from Sarawak. In general appearance this is very like *A. Holttumii*, but is distinguished by the short sori close to the edge, the very short indistinct recurrent veins, and the thicker texture.

MARATTIA Smith.

M. pellucida Pr. ?—Tenompok, in forest by stream (H. 25391, Cl. 27428, 30459).

If rightly named, new to Borneo.

SCHIZÆACEÆ.

SCHIZAEA Smith.

S. malaccana Baker var. **robustior** var. nov.—Leaves up to 25 cm. long by 1 mm. or more wide, spikes 6–7–jugate, usually folded together. Superficially resembling *S. fistulosa*, especially the Hawaiian subspecies *S. robusta* Bak. but agreeing with the type in all important characters.

Marei Parei ridge (Cl. 10919; Gibbs 4039?, an seq.?).

Typical *malaccana*, common in Sarawak, has as a rule much narrower leaves. This species (of which *S. papuana* Brause, Engler's Bot. Jahrb. 56: 211. 1920, is a direct synonym) can easily be distinguished from the following by the yellowish-brown and flat hairs of the rhizome and the subcomplanate fronds.

S. fistulosa Labill.—*S. malaccana* Baker 1879: 44.–s.l. (Burbidge, Haslam), Pakka to Lobang, terrestrial in open forest (Cl. 10591, 10729, H. 25505), rocky ridge below Pakka (Cl. 27952, 28035).

Hairs of the rhizome glossy, castaneous, the spikes 10–15–jugate, the leaves terete, rush-like.

S. digitata (L.) Sw.—Dallas (Cl. 27357).

S. dichotoma (L.) Sm.—Ridge S. of Koung, 3000 ft. (Cl., s.n.).

LYGODIUM Swartz.

L. circinnatum (Burm.) Sw.—Lobang to Kiau (Tp. 1800), Dallas (Cl. 26451).

L. scandens (L.) Sw.—Kiau (Topping 1509).

GLEICHENIACEÆ.

GLEICHENIA Smith.

G. microphylla R. Br. var. **semivestita** (Labill.) v.A.v.R. Handb. Suppl. 80.–*G. vulcanica* Gepp 205.–s.l. (Haviland 1483), Kamborangah (Gibbs 4158, Tp. 1648, Cl. 10353), Marei Parei ridge (Gibbs 4086, Cl. 10947), Pakka (H. 25510), above Kamborangah (Cl. 28015).

I follow v.A.v.R. in naming this fern, which is common on the loftier mountains of the Malayan region, though it is not quite identical with Australian type. Copeland quoted Kinabalu as a locality for *G. vulcanica* Bl., probably on the basis of Gepp's wrong identification of Miss Gibbs' specimens.

This fern is frequent on the Kamborangah ridge in low open forest, especially in the most open places; sometimes it is associated with the next species.

G. borneensis (Bak.) C. Chr. n. sp. *G. circinnata* var. *borneensis* Bak. Journ. Bot. 1879: 37. Cop. Keys: 303.—*Eugleichenia* a specie antecedente differt: Stipite rachibusque subtus teretibus superne planis vel late sulcatis, rachibus secundariis paleis atrocastaneis, scutelliformibus, subbullatis, integris parce onustis. Segmentis minimis, 0.5 mm. longis et latis, marginibus revolutis, subtus glaucis et paleis orbicularibus vel interdum breviter cuspidatis arcte adpressis conspersis. Soris profunde immersis.

KINABALU: s.l. (Burbidge, type, Kew), to above Pakka and Kamborangah (Gibbs 4226, 4231), below Pakka, open places on ridge (H. 25517, Cl. 27470).—Summit of Mt. Murud (Mjöberg).

This is a very remarkable and distinct species, so different from all others that it might very naturally be regarded as the type of a special section of *Eugleichenia*. It has the immersed sori and the flat upperside of stipe and rachises in common with the South African *G. polypodioides* (L.) Sm., but the scales are wholly peculiar. Those of the under side of the rachises of the branches are ovate, entire, vaulted, glossy and nearly black with paler margins, deciduous and often all abraded, those of the under side of the segments firmly appressed to the leaf, mostly orbicular, sometimes shortly cuspidate, entire, somewhat vaulted, reddish brown with paler margins; they are irregularly scattered over the surface, mostly 3–6 in each segment, and recall a kind of Coccidæ. The other characters are less peculiar. The rhizome is horizontally wide-creeping, brown, glossy, terete, with some scales like those of the rachises, soon naked; the stipe 8–15 cm. long; the frond up to 40 cm. long, unbranched or forked with the terminal bud dormant or growing out to an unbranched pinna on a stalk 15 cm. long without pinnules; lateral branches stiffly erect, up to 30 cm. long, 3–5 cm. broad, with pinnules to the base, unbranched or forked. Pinnules and segments in shape and size like those of *G. microphylla*. Sori with 2–4 very deeply immersed sporangia, one (always?) to each segment, basal on the anterior side.

This species grows alongside *G. microphylla*, and also alone, especially in open places on the ridge. It is sometimes associated with very dwarf Dipteris.

G. hirta Bl.—*G. vestita* var. *paleacea* Bak. Journ. Bot. 1879: 38—*G. vestita*, *G. Hallieri*, *G. Warburgii* Copel. Keys 304.—s.l. (Burbidge, Gibbs 4269), Pakka to Lobang (Tp. 1755), Kamborangah (Cl. 10531, H. 25449), Tenompok (Cl. 28785), above Kamborangah on rocks (Cl. 28016).

All specimens named by various authors *G. vestita* belong to *G. hirta*, which is well characterised by its usually very glaucous under surface, by its much narrower fimbriate scales of the midribs and especially by the segments being distinctly toothed at their tips. The specimens from Mt. Kinabalu are more densely chaffy than most others, and might be named var. *paleacea* (Bak.).

G. lævigata (Willd.) Hk.—Kiau (Gibbs 3966, t. Gepp), Koung (H., s.n.).

Associated with *G. linearis* in thickets beside paths on the lower slopes of the mountain.

G. linearis (Burm.) Clarke—Tenompok to Lumu Lumu (H. 25438), Marei Parei ridge (H. 25617), Tenompok (Cl. 29535, 28745).

These collections represent four distinct varieties.

G. bullata Moore—*G. arachnoides* Gepp p. 205.—s.l. (Low, type!, Haviland 1950, Gibbs 3081, Cl. 10724), Lumu Lumu to Kamborangah (H. 25450).—Mt. Tibang (Mjöberg).

This very distinct, thickly coriaceous and densely chaffy species may be identical with the Javanese *G. arachnoides* Mett., but scarcely with *G. volubilis* Jungh., to which v.A.v.R. (Handb. Suppl. 83) referred it. It grows with *G. glauca* in open places on the ridge from about 6000 ft. upwards as far as there is any continuous vegetation, in very exposed places often very much dwarfed.

G. Norrisii Mett.—Tenompok (H. 25405, Cl. 28267, 29430).

var. **floccigera** var. nov.—A typo fere glabro differt: costis nervisque paleis filiformibus stellatis subtus plus minusve villosis, receptaculis itaque dense villosis, sporangiis (plerumque 5–6) juvenilibus a tomento tectis, segmentis non vel leviter emarginatis.

Gurulau spur (Gibbs 3976), Kiau (Cl. 9986).

This variety should be compared with *G. Elmeri* Copel.

The collections of Holttum and Clemens from Tenompok all agree closely with typical material from the Malay Peninsula. They show a few hairs mixed with the sporangia, especially in young sori. In the Peninsula the species is usually found at about 2000 ft. altitude, and has never been found much higher; it is therefore interesting to find it at nearly 5000 ft. on Kinabalu. (R.E.H.).

G. glauca (Thbg.) Hk. var. **longissima** (Bl.).—Lumu Lumu to Kamborangah (Gibbs 4256, H. 25448).

HYMENOPHYLLACEÆ.

HYMENOPHYLLUM J. E. Smith.

H. microchilum (Bak.) C. Chr. Mitt. Inst. Allg. Bot. Hamburg 7: 143. 1928. *Trichomanes microchilum*

Bak. 1894: 250.—*H. Blumeanum* Copel. Keys 307 (part)—s.l. (Haviland 1478, type !), from Tenompok to Lumu Lumu and Kamborangah, on trees (H. 25470, 25735, Cl. 28984, 27070).—Sarawak, Mt. Dulit (Mjöberg).—Dutch Borneo, Bukit Mehepit and Bukit Rajah (Hans Winkler 744, 1042*a*).

A genuine species of *Hymenophyllum*, in general habit closely resembling *H. polyanthos* Sw., but the sori are different, broadly ovate and deeply immersed in the segment with two small free triangular lips and exserted receptacle. Fronds quite glabrous, the segments entire, the stipe winged in the upper half. Known from Borneo only.

H. Blumeanum Spr. sens. lat.—Tenompok (Cl., s.n.).

H. eximium Kunze.—*H. formosum* Bak. 1879: 38.—s.l. (Burbidge, Enriquez 18121), Kamborangah (Cl. 10528, 28010, 28012), Tenompok (H. 25424, Cl. 27791, 26948, 29488), Lumu trail (Cl. 28388), falls above Lumu, on rocks (Cl. 29715).

H. pachydermicum Cesati.—*H. vestitum* Bak. Kew Bull. 1894: 7; *Trichomanes vortitum* Hose p. 39 (err. typ.).—*H. Clemensiae* Copel. Phil. Journ. Sci. 12C: 46. 1917.—Kiau (Cl. 10226), Gurulau spur (Tp. 1619, Cl. 10780), Tenompok to Lumu Lumu (H. 25426), Tenompok (Cl. 29270), near Menetendok (H. 25580), Marei Parei ridge (H. 25618).

All writers have failed to identify Cesati's species because of a misprint in the original description, where the measure "duo decimetra longa" should be "centimetra" (t. sp. orig. Herb. Firenze). It is a small species, distinguished by the numerous reddish hairs on the ribs beneath. It seems to be common in Sarawak, and is also found in South-east Borneo: W. Kutai, Kemul (Endert 3799). *H. pilosum* v.A.v.R., from Sumatra (Barisan Mts., Matthew) and Celebes (Kjellberg 3628) is, I think, the same species.

H. paniculiflorum Presl.—Pakka, on rocks by stream in a mass of bryophytes (H. 25497), above Lumu Lumu (Cl. 28014). New to Borneo.

H. australe Willd.—Pakka, on rock near stream (H. 25501), Tenompok, on tree in forest (H. 25734, small form).

var. **fimbriatum** J. Sm.—Tenompok (Cl. 27425).

H. pilosissimum C. Chr. sp. nov.—*H. obtusum* Bak. 1879: 38, Copel, Keys 307.—*H. obtuso* Hook. et Arn. Hawaiiensi species proxima et cum ea ab auctoribus false conjuncta, differt: majori; stipite exalato ad 3–4 cm. longo; lamina elongato-lanceolata, ad 10 cm. longa, 2 cm. lata, bipinnata-tripinnatifida, supra sparse subtus densissime pilis stellatis molliter lanosa, rachi costique late alatis, segmentis 1 mm. latis.

Kinabalu, s.l. (Burbidge, type, Kew), Lumu Lumu to Kamborangah, on under sides of sloping tree trunks in mossy forest (H. 25460), Kamborangah (Cl. 28983).—Dutch Borneo: Kemul (Endert 4232, p.p.).—Papua: Hunsteinspitze (Ledermann 8460).

Among the species of the group of *H. ciliatum,* this is perhaps the most densely hairy. The undersurface is throughout covered with stellate hairs which bear, on the tip of a central stalk, 4–6 simple horizontal or suberect branches. In *H. obtusum* the midrib and margins only bear the stellate hairs; our species is more narrowly lanceolate in outline, somewhat narrowed toward the base and the apex, though the apex may be sometimes rounded-obtuse. The sori are placed on the tips of the upper segments, the indusia almost as wide as the segments, divided nearly to the base, the valves rounded, densely hairy, sporangia very large.

To this species belong, I think, all other Malayan and Melanesian specimens called by other authors *H. obtusum* and *H. subtilissimum.*

H. badium Hk. et Grev.—Dallas, on rocks by stream, 2500 ft. (Cl. 27315). Sterile specimens.

H. productum Kze.—Tenompok, on mossy stump (Cl. 28228).

LEPTOCIONIUM.

H. johorense Holttum Gard. Bull. S.S. 4: 408. 1929.—Below Pakka, on tree trunk (H. 25482, det. Holttum). New to Borneo.

The least divided *Leptocionium,* not at all related to *H. borneense* Hook. as suggested by Holttum but very near and perhaps the same as *H. perparvulum* v.A.v.R. Bull. Jard. Bot. Buit. II Ser. no. XVI: 18. 1914, from Mt. Singgalang, Sumatra (Matthew 664). From *H. Lobbii* Moore (syn. *H. subflabellatum* Cesati, *Trichomanes serrulatum* Bak.) it differs chiefly by its segments being twice as wide. It may be noted that Moore's and Baker's species were both based on the same collection made by Lobb in 1857 on Lobong Peak, N. E. Borneo; the locality Moulmein quoted by van den Bosch is due to a wrong label at Kew.

H. blandum Racib.—Marei Parei ridge (Gibbs 4228, H. 25605).

H. perfissum Copel. 1917. 47.—Pakka (Cl. 10588).

H. holochilum (v.d.B.) C. Chr.—Pakka to Lobang (Tp. 1680, 1731).

H. Bakeri Copeland, Keys 309.—*Trichomanes denticulatum* Bak.—Pakka to Lobang (Tp. 1733).

Baker's species was wrongly identified with a quite different Samoan plant *(H. praetervisum)* by Christ. The specimens from Kinabalu are sterile, but I think that they belong here. *H. Bakeri* resembles in general habit, size and sori *H. microchilum,* but the segments are remotely toothed and the rachis furnished with a few hairs.

H. Lobbii Moore—*Trichomanes serrulatum* Bak.—Kamborangah (Cl. 28006).

H. serrulatum (Pr.) C. Chr.—Gurulau spur (Tp. 1617, Cl. 10779), Tenompok (H. 25421, Cl. 26850, 28088), Trail to Lumu (Cl. 28386), Bungal to Kalawat, 3000 ft. (Cl. 28174). Very common on mossy trees.

H. thuidium Harr.—*H. physocarpum* Christ.—Dallas-Tenompok ridge (Cl. 26897*a*), Tenompok (H. 25392).

New to Borneo. The specimens are rather small, but otherwise match the type from Panay (Kew). It is very near *H. Reinwardtii* v.d.B. Hym. Jav. pl. 42, and perhaps only a variety of that species, differing in its narrower very much crisped fronds and faintly crenate valves. It is intermediate in its characters between *Euhymenophyllum* and *Leptocionium;* its whole habit is that of the crisped species of the latter section, especially *H. Neesii* and *H. carduncul*us, but the sori are quite different, globose, thick and subbullate, much broader than the segments, the round valves naked on the back, their margins obscurely crenate. The stipe is broadly crisped-alate like the rachis, the segments faintly toothed.—The Papuan *H. physocarpum* (Schlechter 14529, Ledermann 13050*a*, Berlin) is a slightly different form with the valves more coarsely toothed.

H. denticulatum Sw.—Lobang to Kamborangah (Tp. 1645), Marei Parei ridge (Tp. 1881, Cl. 11042 p.p.).

H. Neesii (Bl.) Hk.—s.l. (Low, Burbidge, Enriquez Herb. Singap. 18125), Lobang to Pakka (Gibbs 4144), Marei Parei ridge (Cl. 11042 p.p.), below Kamborangah (Cl. 28008), Tenompok to Lumu Lumu (H. 25425, Cl. 28386), Tenompok (Cl. 28087, 28084), Silau basin (Cl. 28397).

H. fraternum Gepp p. 196 (Gibbs 4071) is, I think, a scanty and poorly fertile specimen of *H. Neesii.*

H. cardunculus C. Chr. Mitt. Inst. allg. Bot. Hamburg 7: 144. 1928.—*H. aculeatum* Gepp p. 197.—Gurulau spur (Gibbs 4020), Dallas to Tenompok, on trees (H. 25351), Silau basin 8000 ft. (Cl. 29027).

This species is very near *Leptocionium acanthoides* v.d.B. Hym. Jav. pl. 32 (syn. *H. sabinifolium* Bak.), differing in the rather densely reddish pilose stipe and rachis.

TRICHOMANES Linn.

T. (Gonocormus) **minutum** Bl.—*T. proliferum* Gepp p. 195.—Gurulau spur (Gibbs 4019).

T. (Gonocormus) **proliferum** Bl.—Gurulau spur (Tp. 1616), Tenompok to Lumu Lumu, on mossy tree trunk (H. 25434).

T. (Gonocormus) **Teysmanni** v.d.B.—near Pakka, on rock by stream (H. 25498).

I am possibly wrong in referring H. 25498 and other Bornean specimens to this species. In general habit and size they resemble *T. pyxidiferum,* and many Malayan specimens in herbaria belonging here are placed under that name; but their thread-fine stipe, their colour and the structure of the somewhat plicate fronds show a close resemblance to the species of *Gonocormus.* They are, however, apparently not proliferous, but on close examination small hairy buds may be found on the upper part of the stipe.

T. dichotomum Kunze.—*T. digitatum* Bak. 1879: 38.—*T. nitidulum* Gepp p. 195, Copel. Keys 312.—s.l. (Burbidge), Pakka (Gibbs 4233, Tp. 1709), Kamborangah to Pakka (H. 25475), Tenompok to Kamborangah (Cl. 28003).

There is evidently only one species of the group of *T. digitatum* occurring on Kinabalu; Miss Gibbs' specimens are small and digitately divided, more resembling *T. nitidulum* v.d.B., but Mr. Holttum's fine specimens consist partly of similar small fronds, partly of some which are much larger and very well agree with the Javanese type (v.d.B. Hym. Jav. pl. 16). In its often much prolonged and remotely pinnate fronds *T. dichotomum* is abundantly different from the genuine *T. digitatum* Sw., which in my opinion does not occur in Malaya. In Borneo this species has hitherto been found on Mt. Kinabalu only.

T. palmatifidum K. Mueller.—*Hymenophyllum borneense* Hk.—Pakka (Tp. 1725), Lumu Lumu to Kamborangah, on tree trunk (H. 25462), Silau basin at 10,000 ft. (Cl. 28207), Masilau (Cl. 29281).

This is the Bornean fern described by Hooker; it differs a little from the Javanese type by the somewhat narrower segments but it is certainly not specifically different.

T. humile Forst.—Below Dallas, on rock by stream (H. 25375, Cl. 27138).

T. bilabiatum Nees et Bl.—Lobang, on vertical rock in forest (Tp. 1779, H. 25554), Tenompok (Cl. 26858).

T. bipunctatum Poir. *sens. lat.*—*T. filicula* Bak. 1879: 38.—s.l. (Burbidge), Lobang to Kiau (Tp. 1799, 1806, Cl. 9955), Tenompok, on tree by stream (H. 25400, Cl.

27119, 28302, 28421, 27756 bis, 28232), Dallas to Tenompok (Cl. 27588), near Kabayau (H. 25627).

T. brevipes Baker.—*T. pyxidiferum* Bak. 1879: 38.—*T. recedens* Rosenst.—*T. microlirion* Copel.—s.l. (Burbidge), near Dallas on small trees near stream (H. 25142, Cl. s.n.).

The sori are often confined to the uppermost, much abbreviated pinnæ, forming a terminal spike (*T. microlirion* Copel.). Copeland would refer these plants to *T. christii* (Phil. Journ. Sci. 51: 185).

T. pallidum Bl.—s.l. (Burbidge, t. Baker, not seen, an seq. ?), near Lumu Lumu (H. 25733).

T. album Bl.—*T. pallidum* Gepp p. 196.—s.l. (Gibbs 4113), Lumu Lumu to Kamborangah, on lower sides of sloping tree trunks (H. 25468, Cl. 28007).

T. pallidum and *T. album*, though differing widely in pubescence, are united by almost all authors. The hairs of *T. pallidum* are rather few, long and slender, patent; those of *T. album* numerous, straw-coloured, rather stiff and appressed to the surface (*see* v.d.B., Hym. Jav. pl. 7–8). *T. pallidum* is on the whole a lowland species; *T. album* occurs only on mountains at rather high elevations.

T. auriculatum Bl.—Kiau to Lobang (Tp. 1639), Tenompok (Cl. 29347), Dallas-Tenompok ridge (Cl. 27736). Usually on trees.

T. maximum Bl.—s.l. (Low, Burbidge, Gibbs 4036), Marei Parei ridge (Cl. 10911), Kamborangah, near stream in forest (H. 25541), Tenompok, (Cl. 28372, 28225*a*), Dallas-Tenompok ridge, in ravine (Cl. 26897), Silau basin, rocks in stream bed (Cl. 29067).

This fine species is nearly always found on wet rocks near streams.

T. papillatum K. Mueller ?—Tenompok to Lumu Lumu, bank of small stream, by water's edge (H. 25430, Cl. 27427, 28225, 28229, 28459, 28740).

H. 25430 is exactly matched by collections from stream sides at similar elevations in the Peninsula. They are distinguished from typical *T. cupressoides* by their more slender habit, narrower fronds with more ascending pinnæ. Their appearance in the field is distinctive, but in the herbarium it is difficult to find definite characters to separate them from *T. cupressoides*. It is possible that their peculiar form is a result of their position of growth, in a zone just above normal water level (often among tree roots) in the earth (not rocky) banks of very shady streams; they must be subject to immersion by floods at fairly frequent intervals. I have seen them abundantly

beside three different streams in the Peninsula at about 4000 to 5000 feet elevation. [R.E.H.].

T. cupressoides Desvaux.—*T. rigidum* auctt. ex p.—Marei Parei ridge (Cl. 11061), Tenompok, by stream in forest (H. 25401), Tenompok to Kamborangah (Cl. 28011).

T. apiifolium Presl. (not Baker 1879).—Tenompok, on rocks by stream (H. 25396, Cl. 28227).

T. Schlechteri Brause, Engler's Bot. Jahrb. 49: 10 1912. var. ?—*T. apiifolium* Baker 1879: 38.—s.l. (Burbidge).—Dutch Borneo: Kemul (Endert 4261).

A very interesting species with reddish-brown, very compact, large fronds, resembling an ostrich-feather, the stipe and rachis long-hairy. The type is from New Guinea. *T. compactum* v.A.v.R. (Nova Guinea 8: 57) is probably a form of the same. I hope to deal in another place with these three forms which seem to be somewhat different in anatomical structure.

T. pluma Hook.—*T. trichophyllum* Moore.—s.l. (Low, Burbidge), Marei Parei ridge (Cl. 11056), Lumu Lumu to Kamborangah, on ground in forest, occasional (H. 25469, Cl. 28013, 28985, 27071, Enriquez 18157).

I cannot see any difference between the two "species" here united.

Trichomanes javanicum Gepp p. 197 (Gibbs 3109) is *Asplenium fuliginosum.*

CYATHEACEÆ.

I follow Copeland in uniting all Malayan tree-ferns in one genus, *Cyathea,* but I arrange the species otherwise, according to the results arrived at during my comparative studies of practically all specimens collected in Borneo, including all types. In another paper I hope to show how the species may be arranged in more distinct groups.

C. capitata Copel. 1917: 49.—Marei Parei ridge (Cl. 11033), Falls above Lumu (Cl. 29987), Lumu Lumu, by stream in forest, caudex 30 cm. high (H. 25447; also Cl. 29109, 27954).—Sarawak: Mt. Murud (Mjöberg).—A very distinct species.

C. kinabaluensis Copel. 1917: 51.—Gurulau spur (Cl. 10840, 10861, Tp. 1634), forest ridges, 4000–5000 ft. (Cl. 27331), Dallas-Tenompok ridge, forest ravine (Cl. 26824).

Perhaps a local race of *C. arthropoda* Copel. from Sarawak (Bongo Range, Mt. Poi). Clemens 26824 shows distinct narrow indusia round the bases of the sori.

C. (Alsophila) **vexans** (Ces.) C. Chr. comb. nov. *Alsophila vexans* Cesati, Atti Acad. Napoli 7, part 8: 4. 1876.—

A. dubia Bedd. *Cyathea dubia* Copel. Keys 349.—Marei Parei ridge (Cl. 10921).

To this species belong probably all Bornean specimens referred by authors to *Alsophila glabra* (Bl.) Hook.

Cyathea alternans (Wall.) Pr.—Bungal Hills, 3,000 ft. (Cl. 29160).

This specimen exactly matches material from the Peninsula, except that it appears to be quite exindusiate. The Peninsular plants of this species are very variable in the extent of the development of the indusia, but all which I have examined show at least a small indusium (R.E.H.).

C. polypoda Baker.—s.l. (Haviland 1479).

This species differs from the following one in these characters: the sori are indusiate, and the costæ and midribs beneath bear crowded pale bullate scales. I am doubtful however whether the two species are really distinct. Further material is required.

C. (Alsophila) **kemberangana** Copel. 1917: 52.—Kamborangah, in more open places in forest (Cl. 10500, H. 25458), jungle ridge above Lumu (Cl. 27954).

Described from a rather incomplete, old frond. From Mr. Holttum's better specimens I add some supplementary notes. Base of stipe with a mass of pale straw-coloured, narrow long-acuminate, minutely ciliate 2–3 cm. long scales, stipe and rachises brown, without scales and hairs, costæ and costules hirsute above, glabrous beneath, midribs of segments with some brown bullate scales beneath. Pinnæ long-stalked, up to 40 cm. long by 13 cm. wide, pinnules on petioles 5 mm. long, articulated to costa, 6 cm. long, 1.5 cm. wide, texture moderately firm (coriaceous in the old type).

This may be the same as *C. polypoda* Bak., but it is apparently exindusiate and the bullate scales much fewer and not pale. It is intermediate between *C. vexans* and *C. squamulata*, but quite distinct in the pale basal scales and the stipitate articulated pinnules which are much deeper incised than in the former species.

A fairly common small tree fern on the ridge at about 6000–7000 ft. This species has also been collected in the Malay Peninsula (R.E.H.).

C. (Alsophila) **squamulata** (Bl.) Copel.—*Alsophila Ridleyi* Baker.—*Cyathea elliptica* Copel. 1917: 51.—Gurulau spur (Cl. 10859).

C. elliptica seems to me quite identical with the co-type of *A. Ridleyi* (Ridley 4401) in the Singapore Herbarium; it is very slightly different from typical *C. squamulata*, and perhaps only young though fertile plants of it. A specimen from Tenompok (Cl., s.n.) is bipinnatifid only. This resembles *Alsophila parvifolia* Holttum from Sumatra in

size, cutting, paleaceous stipe and rachis with bristles below, but is hardly that species. The costæ have whitish bullate scales beneath, and no hairs. I have little doubt that it is a young fertile state of the form of *C. squamulata* described as *C. elliptica* Copel.

C. (Alsophila) **Burbidgei** (Bak.) Copel.—*Alsophila Margarethae* Schroeter.—*Cyathea mollis* Copel. 1917: 52.—Gurulau spur (Tp. 1842, Cl. 10839), Tenompok (Cl. 29569), Dallas-Tenompok spur (Cl. 27741).

Found in several places in Borneo, and I have the same from the Malay Peninsula: Negri Sembilan, Bukit Tangga (Herb. Singapore no. 11830). It is closely related to *C. squamulata,* but the rachises and ribs are more or less hirsute beneath.

C. (Alsophila) **ramispina** (Hook.) Copel. Phil. Journ. Sci. 4C: 36. 1909. *Alsophila ramispina* Hook., Index.—*A. glabra* Baker 1879: 38.—*A. amaiambitensis* and *A. Hallieri* (not Rosenstock) v.A.v.R. Bull. Jard. Bot. Buit. II Ser. no. XXVIII: 1–2. 1918.—*A. kenepaiana* v.A.v.R. l.c. III Ser. 2: 129. 1920.—Lumu Lumu to Kamborangah, abundant in forest on the ridge (H. 25457), ridges above Tenompok (Cl. 28850, 29491).

This is the oldest known species of a special group of *Alsophila* of which several closely related species are now known, *e.g. C. recommutata* Copel, *C. Kingii* (Clarke) Copel., *C. dimorpha* Copel.; it is characterised by dark-coloured rachises, often much contracted fertile pinnules and by the presence of aphlebioid pinnæ at the base of the stipes (these are however absent in *C. Kingii*). The group is, I think, most nearly related to the group of *C. squamulata.* Strangely enough, all species of Alsophila found in Madagascar belong to the same group. *C. ramispina* is known from Borneo only, but is there widespread. It is variable, and it seems that each mountain has its own form, which I cannot, however, regard as distinct species. I refer to it all forms with not contracted fertile pinnules, with the rachises dark brown, not black, and with small bipinnate aphlebiæ which remain as *branched* spines when the pinnules are fallen. The form from Kinabalu is sub-bipinnate with the segments more spaced than in the type, the costules and midribs beneath with crowded, brown, sub-bullate scales. The aphlebiæ are at first green, but soon turn brown; those of the old leaf-bases persist and clothe the trunks of the larger ferns in a remarkable way.

C. (Alsophila) **recommutata** Copel. Phil. Journ. Sci. 4C: 36. 1909.—*Alsophila commutata* Mett., C. Chr. Index.—*Cyathea Toppingii* Copel. 1917: 51.—Gurulau spur (Tp. 1824), in forest (H. 25408, Cl. 28266, 28596).—

Sarawak: Mt. Penrissen (Brooks 60), Mt. Dulit (Mjöberg).

The specimens from Kinabalu are perfectly identical with those from Mt. Dulit, which I have compared with the type of *A. commutata* from Mt. Ophir (Cuming 396, Berlin) without being able to find any reliable differences between them. The species is very near *C. ramispina*, agreeing with it in texture, colour, and scales. The sterile pinnæ are hardly different, but the fertile pinnules are much contracted, often 5 mm. broad only, incised half-way into triangular obtuse toothed lobes with simple veins and small sori close to the midrib. I find another difference in the basal aphlebiæ which are simply pinnate with the pinnæ soon dropping, leaving the lower portion of the rachis as strong, 2 to 3 cm. long, *unbranched* spines. *C. Hewittii* Copel. from Bongo Range, Sarawak, is to me a form of the same species.

C. paleacea Copel. 1917: 53.—Pakka to Lobang (Cl. 10726, Tp. 1669).

A doubtful species, perhaps a dwarf form of *C. Havilandii*, with the same dense vestiture of scales, but it is much smaller and bipinnatifid only or bipinnate with entire pinnules.

From Copeland's remarks and from examination of plants in the field I feel fairly certain that this is an immature form of *C. Havilandii*, which species is very abundant in the low open Leptospermum-Dacrydium forest on the ridge at about 9000 ft. altitude. The plants have very short erect stocks, never tall stems. I saw no evidence of the presence of a second species. Though Cyathea plants are not usually fertile until they have attained their full adult size and leaf-differentiation, I have come across cases in three different species of fertile plants with leaves only bipinnatifid (adult plants being bipinnate-tripinnatifid), and this may be a similar case (R.E.H.).

C. Havilandii Baker 1894: 249.—*C. rigida* Copel. 1917: 53.—*C. dulitensis* Gepp p. 197.—s.l. (Haviland 1485), below Pakka, abundant in low forest on ridge (Gibbs 4280?, Tp. 1758, H. 25509, Cl. 27956, 29805).

A very distinct species, known from Kinabalu only. Trunk short, stipe, rachis and all ribs clothed beneath with a mass of brown scales. Stipe short, very stout, the lamina ovate, about 50 cm. long, 25 cm. wide, rigidly coriaceous. Gibbs 4280 is a scrap, certainly not *C. dulitensis* but probably this.

C. megalosora Copel. 1917: 54.—*Alsophila crinita* Gepp p. 197, *Cyathea crinita* Copel. Keys 351.—Kamborangah to Pakka (Gibbs 4237), Pakka to Lobang (Tp. 1759), Silau basin at 8000 ft. (Cl. 29068, 29714).

Near the Javanese *Alsophila tomentosa* Bl. but the scales entire, not woolly fimbriate, and the indusia large, persistent, thin.

C. **Korthalsii** Mett.—Kamborangah, by small stream (H. 25527), Silau basin 8000 ft. (Cl. 29712). New to Borneo.

The specimen agrees, as to size, shape, scales, veins and sori, exactly with the type from Sumatra, so that I believe my identification is correct. It is a tall tree-fern (to 30 feet), the leaves practically sessile on old plants, being narrowed below almost to the base of the stipe which is clothed with a mass of very narrow, pale brown, rather harsh scales. Younger plants have stipitate leaves. In general, not unlike *C. latebrosa*, but indusia persistent.

C. (Alsophila) **latebrosa** (Wall.) Copel. Phil. Journ. Sci. 4C: 52. 1909. *Alsophila* Wall., C. Chr. Index.—Dallas to Koung, abundant in secondary forest (H. 25625), in forest, Tenompok (H. 25407), Dallas-Tenompok ridge (Cl. 27414, 28158).

C. **longipes** Copel. 1917: 54.—Marei Parei spur (Cl. 10915), Penibukan ridge, in ridge forest (H. 25601).

A distinct species, in its long-stalked pinnules superficially resembling *C. polypoda* but very different in its sharply serrate falcate segments. The slender stipe, which may attain 2 m. in length, is strongly muricate.

C. (Alsophila) **contaminans** (Wall.) Copel. Phil. Journ. Sci. 4C: 60.—*Alsophila glauca* (Bl.) J. Sm., C. Chr. Index.—*Cyathea celebica* Gepp p. 197.—s.l. (Low), Kiau (Gibbs 3965, 3988, Cl. 10236, 10446), Dallas, abundant in valleys by streams (H. s.n., Cl. 26861), ridge above Koung at 3000 ft. (Cl. 29108).

var. **setulosa** Hasskarl Journ. Bot. 7: 324. 1855.—Lobang, by stream 30 ft. tall (H. 25560).

Ribs with long whitish hairs beneath. This form seems to be the commonest in Borneo, and some of the specimens quoted above (*e.g.* Gibbs 3988, =*C. celebica* Gepp) probably belong here.

C. **tripinnata** Copel. Phil. Journ. Sci. 1 Suppl. 251. 1906; 4C: 39.—Tenompok (H. 25409, Cl. 27937, 28695, 29395, 28079). New to Borneo, known previously from the Philippines.

Holttum's specimen agrees very well with the type, differing a little in the rachis being slightly muricate, but the stipe is furnished with many black, short and sharp spines as in the type. The caudex is very stout and the young fronds are covered with large pale chaffy scales. The species is totally different from the other tree-ferns of Kinabalu, but closely related to some other Malayan species, *e.g. C. Teysmannii* Copel. (*C. celebica* v.A.v.R.) which is

certainly the same as *Alsophila ? celebica* Mett. (t. sp. det. Mett.) but probably not *C. celebica* Bl. Copeland listed *C. Teysmannii* as a Kinabalu fern (Keys 350), but it is not in the collections received from him, so that I suppose his record is based on Gepp's wrong identification of Gibbs 3988, which is *C. contaminans*.

MATONIACEÆ.

Matonia Foxworthyi Copel. Phil. Journ. Sci. 3C: 343, pl. 2. 1908.—Marei Parei ridge, edge of forest (H. 25619), below Kamborangah (Cl. 28460).

All specimens from Borneo (Sarawak: Matang, Beccari, Hose 13; Santubong, Matthew; Mt. Poi, Foxworthy 372, 373, Mjöberg: Dutch Borneo: G. Klam, Hallier 2420) belong to this species, which must be regarded as a geographical variety of *M. pectinata* R. Br.

The distinction of *M. Foxworthyi* from *M. pectinata* is not however so clear as Copeland supposed. When he described the former species he had for comparison only specimens of *M. pectinata* with short falcate segments. I have since collected on G. Tahan, in the Malay Peninsula, specimens of *Matonia* which are very little different from Bornean specimens, equalling the latter in length of segments and number of sori (up to 6 on each side of the costa), differing only slightly in the segments being a little more attenuated and slightly more oblique. I obtained also other specimens intermediate between this large form and the commoner small one with rather short falcate segments. It is possible that large size may be connected with particularly favourable growth conditions. It thus appears that *M. pectinata* in the Peninsula has a much greater range of variation than *M. Foxworthyi*, which never produces fronds with short oblique segments. Unfortunately *Matonia* plants are among the most difficult ferns to establish in cultivation, so that it will hardly be possible to verify the differences by cultivation together of plants from various localities. [R.E.H.].

DICKSONIACEÆ.

DICKSONIA L'HÉRITIER.

D. Blumei (Kze) Moore.—Tenompok to Lumu Lumu (H. 25445), Tenompok, flat place in dense jungle (Cl. 28734); Silau basin at 6000 ft. (Cl. 29055). New to Borneo.

The Kinabalu form is rather different from the Javanese type and more nearly resembles the form occurring in the Philippines. It is a very stout tree fern, the stipes

and rachis crinite with cylindrical, deep red-brown, long hairs (a brighter colour on the living plant, which is remarkably handsome), and all ribs beneath densely lanose with soft, pale brown hairs mixed with some cylindrical ones. Perhaps it is a distinct local species.

CIBOTIUM KAULFUSS.

C. Cumingii Kunze var. **arachnoideum** C. Chr. n. var.—A typo Philippinense differt: majore, vix glaucescente, subtus ad costulas pilis longis tenuibus, plerisque antrorsis vel intertextis nec divaricatis instructa et ubique pilis brevibus, pallidis, crispatis arachnoidea, soris per laciniam sæpissime 2–jugis.

Dallas, abundant in old clearings (H. 25378, Cl. 26852), Dallas-Tenompok spur (Cl. 27740), ridge above Koung at 3000 ft. (Cl. 29162), falls above Lumu (Cl. 29672), Gurulau spur (Gibbs 3999?=*C. barometz* Gepp p. 197, Copel, Keys 324).

I now consider *C. Cumingii* a good species which differs from the typical Chinese *C. barometz* by its hirsute axes and by only one pair of sori to each segment. The Kinabalu form is perhaps a distinct local species.

CULCITA PRESL.

Maxon, Journ. Wash. Acad. Sci. 12: 454. 1922. (*Balantium* auctt. Index, not Kaulfuss).

C. Copelandii (Christ) Maxon, l.c., *Dicksonia Copelandii* Chr. Phil. Journ. Sci. 2C: 183. 1907, *Balantium Copelandi* Chr. Copel. Phil. Journ. Sci. 3C: 301, 4C: 62, pl. 19; Keys 335.—Kiau (Tp. 1526, det. Copeland), Tenompok (Cl. 27742). *Balantium pilosum* Copel. Journ. Straits Br. R. Asiatic Soc. 63: 71. 1912 is very likely the same species, but I have seen no specimen for comparison.

POLYPODIACEÆ.

PLAGIOGYRIA (KUNZE) METT.

P. pycnophylla (Kze) Mett.—Pakka (Cl. 10590), in rock crevices, almost to summit (H. 25491, Cl. 28960), Low's Peak, between rocks (Cl. 27043).

P. tuberculata Copeland Phil. Journ. Sci. 1 Suppl. 153. 1906; 38: 391.—*P. sumtrana* Rosenst. in Fedde Repert. 13: 214. 1915.—*P. subrigida* v.A.v.R. Bull. Jard. bot. Buit. III Ser. 2: 163. 1920.—*P. rotundipinnata* Bonap. Notes Pterid. 14: 484. 1923.—*P. pycnophylla* var. *integra* subvar. *stenophylla* Bonap. l.c.—*P. integripinnata* Bonap. l.c. p. 60.

I find in my notes to this species the locality Kinabalu, but unfortunately I have quoted no specimen. It is however highly probable that it occurs there, as it seems to be widely distributed in the Malayan region. I have compared all the types of the species quoted as synonyms and am sure that all belong to this species, which differs from *P. pycnophylla* by its entire pinnæ.

P. glauca (Bl.) Mett.—Marei Parei ridge (Cl. 11070, H. s.n.), at 12000 ft. (Cl. 28385), Dachang (Cl. 29060), Upper Silau basin (Cl. 29716).

This is apparently a rather high level species, but does not occur commonly on the main Kamborangah ridge. I only saw a few sterile plants at about 6000 ft.

P. Clemensiæ Copel. Phil. Journ. Sci. 38: 395. 1929.—Pakka (Cl. 10539, H. 25730), Silau basin at 10000 ft. (Cl. 29059), side of granite dome at 12000 ft. (Cl. 28961), Kamborangah (Cl. 28962).

Intermediate between *P. tuberculata* and *P. adnata*, in colour and coriaceous texture like the former, but resembling the latter in having almost all pinnæ adnate and connected to the rachis by a wing. *P. Clemensiae* is however larger than *P. adnata* (up to 1 m. high) and much more robust, and is also marked by the very thick and flattened rachis. The specimen from Kamborangah is somewhat intermediate in character (*see* remarks under *P. adnata*).

P. adnata (Bl.) Bedd.—"from 7000 to 12000 ft., abundant where open and dry" (Gibbs 4112), above Tenompok, frequent in ridge forest (H. 25442, Cl. 27960, 28186).

This species occurs only on the lower ridges, and is abundant at 5000 to 6000 ft. altitude. In the neighbourhood of Pakka, at about 10000 ft., *P. Clemensiae* is fairly abundant, and extends upwards so far as there is continuous vegetation. But plants occur at intermediate altitudes all the way up the ridge, and some taken by Clemens at Kamborangah (7000 ft.) are of a rather intermediate character, though nearer to *P. Clemensiae*. I noticed no sudden change as I went up the ridge, and it was only on reaching Pakka that I realised how much bigger the plants were than at lower elevations. It is probable that the two species are distinct enough, but that intermediate (hybrid?) forms occur. Miss Gibbs reached the top of the ridge at Kamborangah, and it is probable that all plants seen by her were *P. Clemensiae* or intermediate forms, not true *P. adnata*. [R.E.H.].

DIACALPE Blume.

D. aspidioides Bl.—Marei Parei spur (Gibbs 3108), Lobang (Cl. 10355), Silau basin, among rocks at 7000 ft. (Cl. 29046).

ACROPHORUS Presl.

A. Blumei Ching nom. nov.—*A. stipellatus* C. Chr. part.—*Aspidium nodosum* Bl. (not Willd.).—Pakka, in forest near stream (H. 25499, Cl. 27753), Silau basin, among sheltered rocks at 7000 ft. (Cl. 29276, 29966), Kamborangah (Cl. 28977), Tenompok (Cl. 28837).

All forms of this genus have hitherto been referred to one species but I fully agree with Mr. Ching in segregating the much more finely divided Malayan form from the Himalayan one to which the name *stipellatus* must be confined; a new name for the Malayan form seems to be needed. It is well marked by several good characters, *e.g.* the 4–pinnate frond with very small ultimate pinnules, the distinct indusia, the prickly rachises etc.

STENOLEPIA v.A.v.R.

S. tristis (Bl.) v.A.v.R. Bull. Dep. Ag. Ind. Néerl. 27: 45. 1909.—St. John's Peak, 13100 ft., far under a rock (Cl. 27958, a very dwarfed specimen), Lumu trail at 7000 ft.? (Cl. 27946), on granite dome among shrubs, at 12000 ft. (Cl. 27049A).

This is a very interesting discovery, the species having been known previously only from high mountains in Java. The Kinabalu specimens are all very small, the largest whole frond not much bigger than a pinna of a typical specimen from Java.

MONACHOSORUM Kunze.

M. subdigitatum (Bl.) Kuhn.—Gurulau spur (Gibbs 3111, 4092), Marei Parei ridge (Cl. 10912), below Kamborangah, on ground, rocky place in forest (H. 25544), falls above Lumu, among rocks (Cl. 29938, 29967).

DENNSTÆDTIA Bernhardi.

D. rufidula C. Chr. n. sp.—Rhizomate breve repente, glabrescente, stipitibus approximatis. Stipite ad 30 cm. longo, cum rachi brunneo, pilis brevibus, articulatis dense (parte rachis superiore densissime) villoso et pilis delapsis rugoso. Lamina lanceolata, ad 70 cm. longa infra medium 25–30 cm. lata, versus basi aliquot angustata, versus apicem sensim attenuata, firmiter herbacea, in siccitate rufidula, utrinque (præsertim infra) pilis articulatis, subcrispatis dense villosa, bipinnata. Pinnis alternis, sessilibus, 2–3 cm. inter se

remotis, maximis 20 cm. longis (infimis 6–7 cm.), 3.5 cm. latis, lanceolatis, acuminatis, latere acroscopico paulo quam basiscopico latiore inæqilateralibus. Pinnulis ca. 30–jugis, alternis, 4 mm. inter se remotis, patentibus, maximis lateris superioris 2.3 cm. longis (basali superiore paulo longiore), 3 mm. vel paulo ultra latis, basi decurrentibus, antice excisis, obtusis, profunde pinnatifidis, lobis 6–8 utroque latere, oblongis, integris, marginibus subreflexis, acroscopicis quam basiscopicis paulo longioribus (præsertim basali). Venis indistinctis, intra marginem in hydathodas terminantibus. Soris prope sinus inter loborum positis, plerumque sub pilis occultis, indusiis poculiformibus, sæpe reflexis.

KINABALU: near Tenompok, on shady bank by bridle path (H. 25298, type in Herb. C. Chr.; Cl. 26827, 27465, 26977). Plate 51.

A very distinct new species, only to be compared with the Himalayan *D. appendiculata* (Wall.) J. Sm., but not so deeply cut and wholly peculiar in its densely villous fronds.

D. ampla (Bak.) Bedd.—Tenompok, frequent in forest near streams (H. 25406, Cl. 28341, 28281, 29435, 29602).

D. scabra (Wall.) Moore var. **tenuisecta** C. Chr. n. var.—A typo differt: segmentis ad 4 mm. longis et haud 1 mm. latis, distantibus.

The rhizome is densely covered with rusty brown hairs 2–3 mm. long; the stipe finely scabrous, dark purplish at the base, 50 cm. long; the frond 45 cm. long and 20 cm. wide; the rachis light castaneous, fading to yellowish above, polished and slightly scabrous. The basal (largest) pinnæ are 18 cm. long and 9 cm. wide. The ultimate segments are separated by their own width, about 4 mm. long and less than 1 mm. wide, the veins raised beneath, and the texture firmer than that of the type.

Kamborangah (H. 25520). Only two plants found, with one fertile leaf.

D. cuneata (J. Sm.) Moore.—*D. gomphophylla* (Bak.) C. Chr.—Lobang (Tp. 1782), near Tenompok (H. 25289, Cl. 26976).

The type of *D. gomphophylla* from Mt. Matang, Sarawak (Hose 11, Kew) agrees with type of *D. cuneata* var. *obtusa* Copel. Phil. Journ. Sci. 7C: 63. 1912, which variety "it is not worth while to try to distinguish" (Copel. Keys 324). Copeland, following v.A.v.R., distinguished *D. gomphophylla* from *D. cuneata* by its scandent or twining frond, but neither Baker nor Hose describes it as twining and the type specimen has not the appearance of being so. The fronds of the Kinabalu form are erect, pale green, 4 m.

high, the rhizome stout (2.5 cm. diameter), creeping. It is a very striking fern, and evidently not abundant on Kinabalu.

MICROLEPIA Presl.

M. Hookeriana (Wall.) Presl.—*Nephrolepis (?) marginalis* Copel. 1917: 49.—Gurulau spur (Tp. 1632, Herb. Copel.), near Dallas, terrestrial in forest (H. 25138), Tenompok (Cl. 30460, 28092, 27950, 27407).

Holttum's more complete specimen, exactly matching the type of *N. marginalis,* agrees so well with specimens from Himalaya and Tonkin that at best it can be distinguished as a geographical variety, chiefly differing from the type by the lack of long setaceous hairs on the ribs beneath; the under side is however not quite glabrous but furnished with very short scattered hairs. The pinnæ are also less distinctly auriculate. The creeping rhizome is densely clothed with red-brown hairs as in other species of the genus, not scaly as in *Nephrolepis.* According v.A.v.R., *M. Hookeriana* has been found in Sumatra and Java; previously it was known from North-eastern India to South-east China and Tonkin. *Microlepia phanerophlebia* (Bak.) C. Chr., from the latter country, where it seems to be common, is to me the same species.

M. Ridleyi Copel. Phil. Journ. Sci. 11C: 39. 1916.—near Tenompok, terrestrial (H. 25296, Cl. 26978, 26979, 27527 part). New to Borneo.

The specimen agrees with another from Pahang (Burkill 16699), received from Singapore under this name, but I am not at all sure that it may be distinguished from *M. majuscula* Lowe, to which I have referred a specimen from Sarawak (Lundu, Hose 314, at Kew), but which is probably the same. It differs chiefly from other species of the group by its almost completely glabrous fronds.

M. strigosa (Thbg.) Presl.—Gurulau spur (Tp. 1832), near Lobang, in forest near river (H. 25564), near Tenompok (Cl. 27907).

Microlepia manilensis Pr.—Tenompok (Cl. 27527 pt., 28175, 28236, 28570, 28683, 29683, H. 25381), Falls above Lumu (Cl. 29941).

Like all big species of this genus, *M. manilensis* is very variable in the degree of cutting, which depends largely on the age of the individual and the size of the fronds. The species is well marked by the slightly hairy frond, and especially by the large sori with persistent cup-shaped indusia.

This is an abundant species at Tenompok, in wet places on the edge of the forest, and attains a very large size; specimens collected by Clemens are described as 3 to 4

metres high. Young plants of a much smaller size may also be fully fertile.

M. speluncæ (L.) Moore var. **villosissima** C. Chr. Gard. Bull. S.S. 4: 399. 1929.—Kabayau, grassy slopes by rest-house (Cl. 27672), Dallas, ravine (Cl., s.n.).

HYPOLEPIS BERNHARDI.

H. punctata (Thbg.) Mett. (*Dryopteris*, Index).—Dallas to Tenompok, on bank by edge of forest (H. 25299, Cl. 26980), Tenompok (Cl. 29497), Kundasang (Cl. 29239, 29110).—New to Borneo.

In all essential characters typical, but very much larger than East-Asiatic specimens; frond 2 m. high, the pinnæ to 45 cm. long.

H. tenuifolia (Forst.) Bernh.—Kamborangah, edge of river, in a dense fern thicket (H. 25535).

The only Bornean specimen seen by me. It is very like the commonest Polynesian form which differs from *H. punctata* chiefly by the much larger and persistent false indusia. This species has often been recorded from Malaya and continental Asia, but most specimens so named belong either to *H. punctata* or other species; *e.g.*, a specimen from Pahang (G. Tahan, Holttum 20753) which I identify with *H. bivalvis* v.A.v.R. Bull. Jard. Bot. Buit. II Ser. no. XVI: 19. 1914, from G. Sago, Sumatra (Matthew 700).

H. Brooksiæ v.A.v.R. Bull. Jard. Bot. Buit. II Ser. no. XXVIII: 29. 1918.—Tenompok, in clearing (H. 25411, Cl. 29485, 28366, 27789, 26809). New to Borneo, previously known from Sumatra and the Peninsula.

Stipe and rachises spiny, sparsely hairy, soon glabrous; lamina much firmer in texture than the two former species, brown when dried. Resembling this species in texture, colour, and cutting is *H. tenuifolia* Copel. Keys: 331 from Pakka (Tp. 1671), the axes however are not spiny but minutely and densely rugose with small raised points, and densely pubescent with short reddish articulated hairs. It may be a distinct species approaching *H. rugulosa* (Lab.) J. Sm. or a high-alpine form of *H. Brooksiae*.

PÆSIA ST. HILAIRE.

P. radula (Bak.) C. Chr.—Below Pakka, open place on ridge (H. 25474, Cl. 27957), Granite dome, sheltered place, 11000 ft. (Cl. 28974), Silau basin, on rock at 7000 ft. (Cl. 29047).

New to Borneo, known previously from Sumatra and recently also found in Celebes (Kjellberg 3576). This has nothing to do with the supposed species of Copeland (Keys 331) which is the same as *Davallia* Baker, transferred by me to *Sphenomeris*, which see.

PTERIDIUM Gleditsch.

P. esculentum (Forst.) C. Chr. comb. nov.—*P. aquilinum* subsp. *esculentum* C. Chr. Index.—Dallas, abundant in old clearings (H. 25377, Cl. 28156), Kundasang (Cl. 29107).

This is to me as good a species as most others; it is found in several places in Borneo, which is interesting because it belongs to the southern element which is sparsely represented in the Bornean fern flora, *e.g.* by *Schizaea fistulosa* and the species of *Blechnum* § *Lomaria*. *P. esculentum* extends northwards to Cambodia. A form of *P. aquilinum* also occurs in Borneo.

DAVALLODES Copeland.

D. borneense (Hk.) Copel. Keys: 336. 1917. *Dryopteris? borneensis* O. Ktze., C. Chr. Index (with synonymy).—*Davallia nephrodioides* Bak., C. Chr. Index; *Humata nephrodioides* v.A.v.R. Handb. 295; *Leucostegia nephrodioides* Copel. Keys 336; *Davallodes nephrodioides* Copel. Phil. Journ. Sci. 34: 249. 1927.

Kinabalu: (Cl. 10322), Kadamaian river, on rocks near Menetendok gorge (H. 25573, Cl. 29562). Sarawak: often collected. Dutch Borneo: W. Kœtai, Long Hut (Endert 2620). New Guinea: Sattelberg (Keysser 17).

The type-specimens of Hooker's *Lastrea borneensis* and Baker's *Davallia nephrodioides* are to me fully identical.

D. Burbidgei C. Chr. n. sp.—*D. hirsuto* Copel. similis, a qua specie differt: Lamina versus basin longe et gradatim attenuata, stipite 2–10 cm. solum longo, indusiis angustis cylindricis, 0.5 mm. longis, ore recte abscisso vix dilatato, parce ciliato vel glabro, lateribus toto connatis. Lamina lanceolata, ad 60 cm. longa, medio 7–14 cm. lata. Indusii formatione *D. grammatosoro* Copel. similis, differt: lamina longe attenuata, characteribus aliis vix a *D. hirsuto* diversa.

Kinabalu: Koung (Burbidge, Kew; *Davallia ciliata* Baker 1879: 39; 1894: 251; Hose p. 46), Kadamaian river, on trees (H. 25567). Sarawak: Mt. Bengkarum (Brooks). Dutch Borneo: Liang gagang (Hallier 2774).

This very distinct species was described in MS before Copeland published his monograph of the genus (Phil. Journ. Sci. 34: 242. 1927). He there described a new species from New Guinea, *D. dolichosorum*, which shows the same essential characters as our species, but it is practically glabrous while *D. Burbidgei* is furnished with rather many slender hairs on the ribs beneath.

LEUCOSTEGIA Presl.

L. hymenophylloides (Bl.) Bedd. (*Davallia* Index, *Araiostegia* Copel. Phil. Journ. Sci. 34: 241. 1927).—Lobang (Cl. 10351, 10388), Tenompok, on trees, frequent and varying much in size (H. 25353, Cl. 28545, 28097, 29230, 27121); Silau basin, rock in river bed at 7000 ft. (Cl. 28446).

This species is the type of Copeland's new genus *Araiostegia*, which should probably be adopted, but I am not sure that all species referred to it by him are congeneric.

L. immersa (Wall.) Pr.—Falls above Lumu, in gorge, epiphyte, at 7000 ft. (Cl. 29982).

HUMATA Cavanilles.

H. repens (L. fil.) Diels.—*H. intermedia* C. Chr.—below Dallas, on trees by stream (H. 25725), top of Menetendok gorge (Cl. 29626), above Dallas (Enriquez 18108).

To this species I refer most forms with the fertile leaves not contracted and as a whole like the sterile ones. Besides the typical form with broadly deltoid, pinnatifid leaves or at best the basal pinnæ free, which also occurs in the Malagassian region, we find in Malaya a number of rather different forms, large and small, *e.g. H. intermedia* (*Davallia pinnatifida* Bak.) from Niah, Sarawak (Hose 179, Kew) with the fronds elongate and less broadly deltoid, pinnatifid to the base, the basal segments slightly incised. Another form of *H. repens* is, I think, *H. Brooksii* Copel., Phil. Journ. Sci. 7C: 64. 1912, from Mt. Poi, Sarawak (Brooks 134, Mjöberg), which also is less deltoid but fully pinnate in the lower half, the free pinnæ deeply pinnatifid. Holttum's specimens from Kinabalu are large, rather scaly, and pinnate below, thus approaching *H. Brooksii*. They are almost exactly matched by specimens from the Malay Peninsula. Clemens 29626, from a similar altitude, is much smaller (fronds only 3.5 cm. long). Probably nutrition, exposure and age have much influence on the form of the leaves of this species. There may be local races, but they do not appear to be clearly distinct.

H. alpina (Bl.) Moore?—s.l. (Haviland 1491), Marei Parei ridge (Cl. 11071), near Kamborangah, in low forest (H. 25724), Tenompok (Cl. 26810?).

The specimens quoted would no doubt formerly have been named *H. alpina*, but I am now not at all sure that they belong to that species; I am rather inclined to believe that they are small forms of the following species (*H. kinabaluensis*), from which they differ by being more dimorphous and having much broader sori. Typical *H.*

alpina is a small fern with more or less dimorphous, deltoid bipinnatifid leaves, the fertile segments usually with a tooth protruding beyond the sorus. It seems that Copeland has confounded *H. repens* and *H. alpina;* several specimens named by him *H. repens* should in my opinion be referred to *H. alpina,* and rather typical forms of *repens* he has called *intermedia.*

H. kinabaluensis Copel. 1917: 48.—Pakka (Tp. 1745), near Tenompok on old tree trunk (H. 25295, Cl. 27607), Silau basin 6000–9000 ft. (Cl. 29063).

Near *H. alpina,* and it is possible that the specimens quoted under that species are small forms of this. It is more decidedly dimorphous, the leaves deltoid-elongate, rather densely scaly beneath with red-brown ovate scales, bipinnatifid or bipinnate below, the largest sterile leaf seen 12 by 6 cm., with stipe 7 cm. long; the secondary segments oblong to obovate, 3 mm. wide, entire below the faintly crenate and broadly obtuse apex, decurrent at base; fertile frond contracted with 3 to 6 sori to each secondary segment without protruding teeth. This typical form resembles the Polynesian *H. botrychioides* Brack. more than any other Malayan one. To *H. kinabaluense* I refer with a little doubt some specimens from Pahang: G. Berumban (Henderson 17989) and G. Tahan (H. 20733).

var. **subvestita** C. Chr. n. var.—Much larger than the type, sterile and fertile fronds of the same size (stipe 10–12 cm., lamina 13–17 by 8–10 cm.), the basal pinnæ much the largest, the fertile secondary segments or pinnules serrate with up to 10–12 sori each.

Lobang, on tree in open place (H. 25549). Sarawak: Mt. Murud (Mjöberg).

In size and habit this form resembles more nearly *H. vestita* (Bl.) Moore, to which I have previously referred it, but after a comparison with an authentic specimen of that species at Kew I have arrived at the conclusion that it is a rather large form of *H. kinabaluensis,* with which it agrees in all important characters. *H. vestita* differs in its somewhat more dissected fronds, acute segments, and especially in its much smaller sori, usually with a protruding tooth, thinner texture and dark veins. Intermediate between these large forms is *H. puberula* Copel., Phil. Journ. Sci 7C: 64. 1912, from Mt. Penrissen, Sarawak (Brooks 135, Mjöberg). It is described as hairy, but the "hairs" are evidently a parasitic black fungus which is often found on coriaceous tropical ferns. No species of the genus has true hairs.

DAVALLIA SMITH.

D. Lorrainii Hance.—Kundasan, on tree (Cl. 29105).—Dutch Borneo: W. Koetai, Kemoel, (Endert 1925 no. 3604).

These are the first records of the species in Borneo. It has been collected previously in the Peninsula and the Philippines. The specimens from Luzon (Loher 1115, Elmer 6490) and Mindanao (Elmer 10690) were all distributed as *D. bullata*, which resembles *D. Lorranii* in size and division; the latter species however is very different in its linear densely fringed rhizome scales, in which character it agrees very closely with *D. trichomanoides* Bl. (syn. *D. dissecta* J. Sm., Ind. Fil., under which name it is much cultivated), and the species may be identical.

D. Lobbiana Moore.—Tenompok (Cl. 26856, sterile; 26892).—Bettotan near Sandakan (Boden Kloss 19093).

I doubt if this is a good species, and think it to be probably a local form of *D. divaricata*, differing a little in its less decompound fronds (at best tripinnate) and its shorter and broader indusia. Probably *D. Lobbiana* will prove to be identical with *D. decurrens* Hk., but as this is not certain I prefer to use here the former name, originally given to a Bornean plant.

D. embolostegia Copel.—Pakka to Lobang (Tp. 1747, 1780), near Tenompok (H. 25415, Cl. 26145, 26856 fertile only, 27120, 27790, 27803), Silau basin at 7000 ft. (Cl. 29051).

The indusia on some fronds are narrow with a long rostrum, on others broader with a short rostrum; it appears that the latter condition is found only in fully mature fronds.

TAPEINIDIUM (Pr.) C. CHR.

T. pinnatum (Cav.) C. Chr.—Gurulau spur (Gibbs 3979, t. Gepp. an seq.?), Penibukan ridge, frequent in forest on ridge top (H. 25603).

T. biserratum (Bl.) v.A.v.R. Handb. Suppl. 509. 1917.—*Davallia biserrata* et *gracilis* Bl.—*D. luzonica* Hook.—*D. Hosei* Baker Journ. of Bot. 1888: 323; *Leucostegia Hosei* Copel. Keys 336.—*Davallia oligophlebia* Baker l.c., *Tapeinidium oligophlebium* C. Chr. Index.—Gurulau spur (Tp. 1621, 1826), Lobang, on steep rocky slope in forest (H. 25546), Bungal (Cl. 27839), Tenompok (Cl. 28350).

An extremely variable species, referred by almost all writers to *T. pinnatum* as a variety. All its forms differ however in several important characters from typical

pinnatum, e.g., the dark green deltoid leaves and more or less incised pinnæ, the basal ones often very much prolonged. *T. oligophlebium* is, I think, only a dwarfed form.

SPHENOMERIS Maxon,

Journ. Wash. Acad. Sci. 3: 144. 1913.

S. chinensis (L.) Maxon l.c.—*Odontosoria* Index, Copel, Keys 343.—Koung (Burbidge), Kaningau plain (Gibbs 2976), Kiau (Tp. 1506), Ridge above Bungal (Cl. 29161), Dallas (H. s.n.).

Exceedingly abundant on the steep banks beside the briddle paths.

S. Veitchii (Bak.) C. Chr. comb. nov. *Davallia Veitchii* Baker 1879: 39; Copel. Keys 340.—*Paesia?* sp. Copel. Keys 331.—s.l. (Burbidge), Marei Parei spur (Tp. 1876).

A remarkable fern, mostly resembling a finely cut *S. chinensis,* with a similar creeping rhizome clothed with cylindrical castaneous, septate hairs. Stipe up to 35 cm., glossy, glabrous as the whole leaf, lamina coriaceous, lanceolate or deltoid-oblong, 30–40 cm. long, 4–pinnate, the largest pinnæ 10 cm. long, deltoid, ultimate segments under 1 mm. wide, thick, often cleft at the apex, with a single vein. Sori one to each segment, very like those of *Trichomanes,* campanulate or turbinate, immersed and free at the mouth only, about 1 mm. long.

SCHIZOLOMA Gaudichaud.

S. Jamesonioides (Bak.) Copel.—s.l. (Burbidge, type), Marei Parei ridge (Haviland 1495, Gibbs 4061, Cl. 10909, 11063, H. 25607). In rock crevices in a fully exposed place on the open ridge, the young fronds bright red.

S. induratum (Bak.) C. Chr. is said to have been collected on Kinabalu by Haviland (Hose, p. 49), but as it is not in Stapf's list the record is doubtful.

LINDSAYA Dryander.

Most species of this difficult genus found on Kinabalu were dealt with by Holttum in his paper: The genus Lindsaya in the Malay Peninsula, Gard. Bull. S.S. 5: 58–71. 1930, to which I refer in the following. The identification of some species is due to Holttum.

L. plumula Ridl. Journ. Mal. Br. R. Asiatic Soc. 4: 22. 1926.—Tenompok Silau creek, on rocks in stream (Cl. 28603).

This matches very closely the type of the species, which was found on G. Tahan in the Malay Peninsula at about the same altitude and growing under exactly similar conditions.

L. concinna J. Sm., Hook. Spec. Fil. 1: 205 pl. 61B.—*L. gracilis* p.p. C. Chr. Index.—Koung to Kiau (Tp. 1504, Cl. 9891).

L. scandens Hook., Holttum l.c. 62 (incl. *L. lancea* auctt. as to Malayan plants, Copel. Keys 342).—*L. pectinata* Baker 1879: 40.—s.l. (Burbidge), Marei Parei ridge (Tp. 1871).

I agree in considering the Malayan *L. lancea* to be a bipinnate form of *L. scandens*, although that keen pteridologist, the late Prof. Hieronymus, in his last paper (Hedwigia 62: 14. 1920) segregated it from the true American *L. lancea* as a distinct species, *L. parasitica* Wall.

L. pectinata Bl., Holttum l.c. 62.—Gurulau spur (Gibbs 4001, doubtful), Tenompok-Lumu Lumu (H. 25435), Marei Parei ridge (H. 25608), Tenompok (Cl. 28597).

The earliest leaves of this species, so far as I was able to see, always resemble the later ones in form (thought not in size); they are not finely dissected as are those of *L. repens*.

L. repens (Bory?) Bedd., Holttum l.c. 63.—Lobang to Kiau (Tp. 1807), Gurulau spur (Tp. 1841), near Dallas, on rocks by stream and on trees (H. 25145), Tenompok (Cl. 28266, 27189, 29507, 26651), Lumu Lumu to Kamborangah (Cl. 28002).

I fear that the specific name usually given to this common Malayan species must be changed, because the original *Dicksonia repens* Bory from Réunion is no doubt quite another species, near *L. cultrata*. The rhizomes of the Malayan plants produce finely dissected bathyphylls, which look different in different specimens, indicating perhaps that "*L. repens*" is really an aggregate.

L. tenera Dryander, Holttum l.c. 64.—*L. orbiculata* var. C. Chr. Index.—*L. gomphophylla* Bak. (t. sp. orig. Kew).—Near Dallas, in forest (H. 25149, 26895).

L. borneensis Hook., Holttum l.c. 65.—Marei Parei ridge (Tp. 1851).

L. diplosora v.A.v.R. Bull. Jard. bot. Buit. II Ser. no. XVI: 21. 1914.—Lumu Lumu to Kamborangah, on bases of trees in open mossy forest on ridge (H. 25459, Cl. 27061, 28001, 28963). New to Borneo. Described from Sumatra: G. Singgalang (Matthew 523!).

var. **acrosora** C. Chr. n. var.—Larger than the typical form of the species (pinnæ to 25 cm. long), herbaceous, and the narrower pinnules constantly monosorous.

Marei Parei ridge (Cl. 11045).—Sarawak: Mt. Tibang, 1400–1700 m. (Mjöberg, type, in Herb. C. Chr.). Dutch Borneo: W. Kutai, Kemul (Endert 4367).

L. diplosora belongs to a small group of bipinnate, Malayan species with free or occasionally anastomosing veins, wide-creeping, cylindrical, brown and glossy, asperulous rhizome, and terete stipes. The oldest known species is *L. rigida* J. Sm. from the Peninsula, which is marked by coriaceous leaves with much thickened margins and prominent veins; the pinnules are usually monosorous with a single sorus at the tip, but sometimes with two or three sori. Such a form is *L. triplosora* v.A.v.R., l.c., from G. Sago, Sumatra (Matthew 686!) and W. Kutai, Kemul, Borneo (Endert 4267), which is less coriaceous with the veins hardly raised, but otherwise like *L. rigida,* and in my opinion not specificially different. Very near, perhaps too near, *L. rigida* is *L. monosora* Copel. in Elmer's Leaflets 2: 398. 1908, from Negros; *L. monosora* Rosenst. Nova Guinea 8: 720 (syn. *L. monocarpa* C. Chr. Index Suppl. 49. 1913) is identical, and has recently been found also in Celebes (Kjellberg 3571). *L. monosora* differs from *L. rigida* chiefly in its much narrower and less coriaceous pinnules which are constantly monosorous; their margins are distinctly thickened, and I am inclined to think this a shade-form of *L. rigida.*

From all these *L. diplosora,* with its variety, differs by its more ascending pinnæ and especially by the *thin* margins and rather thin texture. H. 25459 is exactly like the type, the broadly truncate pinnules with two sori (or occasionally only one). Var. *acrosora* is different in the characters mentioned above. The veins of both forms are free, by which character the variety differs from *L. longissima* Christ, a species of the same group with pinnæ up to 60 cm. long.

Whether all these forms are really specifically different must be decided by studies in the field. It seems probable to me that the differences between them may be due to different habitat conditions.

L. decomposita Willd., Holttum l.c. 66.—Marei Parei spur (Gibbs 3079?), Lobang (Cl. 10362), Kamborangah, in valley forest (H. 25729).

This species is here taken in its wide sense. The two specimens seen are not quite identical, but they cannot properly be referred to any species described by Holttum. No. 25729 is near the type as I understand it, having narrow indusia which are rather remote from the edge of the lobe.

L. recurvata Wall., Holttum l.c. 66.—below Dallas, on shady bank by stream (H. 25132, Cl. 27267), Dallas-Tenompok ridge (Cl. 27744?). The smaller fronds have quite

entire and obtuse pinnæ; the basal pinnæ of the larger fronds are lobed into 4 or 5 segments. Cl. 27744 may be distinct species; it has the decurved pinnæ not more than 1 cm. long.

L. nitida Copel. Phil. Journ. Sci. 6C: 138, pl. 21. 1911.—Marei Parei spur (Tp. 1866), Penibukan ridge (H. 25602).

The simply pinnate form of this species, I think; in Sarawak pinnate and bipinnate fronds seem to be equally frequent. I am inclined to believe that it is not specifically different from *L. nitens* and that *L. integra* Holttum l.c. 67 may be a form of the same. *L. nitida* differs from *L. integra* by its not ascending pinnæ; from *L. recurvata* by its smaller pinnæ (14 by 6 mm.); and from both by its shining upper surface.

L. kinabaluensis Holttum sp. nov.—Rhizomate breve repente, stipitibus approximatis, 4–angulatis, stramineis vel subcastaneis. Frondibus plantarum juvenilum pinnatis, stipitibus 6 cm. longis; frondibus plantarum adultarum bipinnatis, stipitibus ad 20 cm. longis. Lamina frondium pinnatarum ad 14 cm. longa 2 cm. lata; pinnis c. 25–jugis, infimis maximis, recurvatis, margine superiore lobatis, ceteris integris, superioribus apicem versus sensim reductis, medialibus triangulatis, margine inferiore curvata adscendente, margine superiore fere horizontale, ad 10 mm. longis, basi ad 5 mm. latis, apice anguste rotundatis; venis reticulatis, areolis 2–seriatis, areolis inferioribus c. 6; soris continuis marginem superiorem totam occupantibus (pinnis inferioribus lobatis exceptis); indusiis angustis crispatis. Pinnis frondium bipinnatarum 1–3–jugis, maximis 9 cm. longis 1 cm. latis, pinnulis 25–30–jugis, superioribus sensim reductis, ceteris subtriangularis vel trapezoideis, maximis 5 mm. longis, basi 4 mm. latis, margine inferiore leviter adscendente, margine superiore fere horizontale apicem versus decurvata, apice anguste vel late rotundata vel subtruncata; venis paucis, anastomosantibus vel liberis (soris exceptis); rhachi 4–angulato, supra canaliculato.

KINABALU: Dallas (Cl. 27744, simply pinnate stage), Tenompok (H. 25433, bipinnate fronds).

A member of the group of *L. decomposita*, with very small pinnules. Though the collections of juvenile and adult fronds were made separately, there is little doubt that they represent the same species. The simply pinnate fronds are fully fertile. The same condition is found in *L. recurvata* and other species; always the pinnules on the bipinnate fronds are smaller than the pinnæ of the juvenile simply

pinnate fronds, the veins fewer, and anastomosis consequently less. If it should happen that I am wrong in regarding the two collections here cited as being forms of the same species, the bipinnate specimen should constitute the type of *L. kinabaluensis.* (R.E.H.).

L. davallioides Bl.—Tenompok, near stream in forest (H. 25403, Cl. 28215). Smaller leaves simply pinnate, larger tripartite.

L. parallelogramma v.A.v.R. Bull. Jard. bot. Buit. III Ser. 5: 212. 1922. Holttum l.c. 70.—Dahobang river, in forest above river (H. 25597).

Though closely allied to *L. davallioides,* I believe this species is distinct. It has quite a different aspect in the field, and in specimens seen by me the degree of dissection and the venation are reasonably constant. (R.E.H.).

L. crispa Baker 1879: 39; Ic. Plant. 1627.—*L. impressa* Chr.—s.l. (Burbidge, type), Tenompok, in forest (H. 25420, Cl. 28645), near Lobang. (H. 25728?).—Sarawak: Mt. Dulit (Mjöberg). Dutch Borneo: Amai Ambit (Hallier 3137).

This very distinct species was described and illustrated by Baker from incomplete specimens consisting mainly of short pinnate leaves; there is also however a fragment of a frond on a stipe 22 cm. long, not mentioned by Baker, which proves that *L. impressa* Chr. is the same species. As neither Baker's nor Christ's description is adequate I give a new one from Holttum's complete specimen.

The short creeping rhizome bears a rosette of simply pinnate leaves, up to 25 cm. long by 3 to 3.5 cm. wide, the stipe 5–6 cm. long, quadrangular, brownish (or stramineous) ; pinnæ numerous, close, alternate, sessile, dimidiate, subrectangular, the largest 2.5 to 2.7 cm. long, 4 mm. wide, the lower edge straight or decurved, the inner truncate, the upper irregularly dentate, the apex subtruncate, dentate, texture thinly herbaceous, veins somewhat raised above, impressed beneath making the pinnæ wrinkled, anastomosing and forming a row of oblique areoles above the much thickened costuliform lower margin; in smaller leaves the veins are free or only occasionally united. These smaller leaves are sometimes fertile with short sori at the tips of the teeth (not in Holttum's specimen). Among these leaves one or two normal fertile ones are raised on reddish-brown *terete* stipes up to 30 cm. long, the lamina bipinnate with 1–2 pairs of lateral ascending pinnæ, 10 cm. long, the terminal pinna 15 cm. long by 2.5 cm wide, lanceolate, acuminate, rachis reddish, quadrangular, with all 4 angles raised and sharp; the pinnules dimidiate, triangular, 1.5 cm. long, 4–5 mm. wide at the truncate base, gradually narrowed from the base to the acute point, the lower edge

straight, the upper entire, the veins united as in the smaller leaves but not rarely free, not nearly so impressed (or not at all) as in the sterile fronds, the pinnules, therefore, not folded into wrinkles; all pinnules fertile with one continuous (rarely interrupted) marginal sorus along the upper edge, which like the indusium is undulate.

L. crispa is a unique species of doubtful relationship; I do not know any species resembling it. It is known from Borneo only.

TÆNITIS Willdenow.

T. blechnoides (Willd.) Sw.—Dallas (Cl. 27218), Penibukan ridge (H., s.n.).

OLEANDRA Cavanilles.

O. oblanceolata Copeland, Phil. Journ. Sci. 7C: 64. 1912.—Marei Parei spur (Cl. 11053), near Lumu Lumu, in ridge forest (H. 25723), above Lumu, on fallen tree (Cl. 27210), Tenompok (Cl. 28763), Dallas-Tenompok ridge (Cl. 28337).

Very doubtfully different from *O. colubrina* (Blanco) Copel. I have seen some Bornean specimens which are intermediate between the two species recognised by Copeland.

NEPHROLEPIS Schott.

N. radicans (Burm.) Kuhn.—Dallas, East ravine (Cl. 27297, sterile).

N. acuminata (Houtt.) Kuhn.—Gurulau spur (Cl. 10774), Dallas (Cl. 26925), Tenompok (Cl. 28065).

N. hirsutula (Forst.) Pr.—Kundasang (Cl. 29241).

N. barbata Copel.—Menetendok gorge (Cl. 29548).

This matches perfectly Copeland's type from Mindanao. It is a new record for Borneo. The species also occurs in the Malay Peninsula, having been reported previously as *N. exaltata*. It always grows on rocks and trees, with often very long pendulous fronds, rather pale green in colour.

ARTHROPTERIS J. Smith.

A. obliterata (R. Br.) J. Sm.—Dallas-Tenompok trail, climbing tree (Cl. 27383), Tenompok (Cl. 29568).

CYSTODIUM J. Smith.

C. sorbifolium (Sm.) J. Sm.—*Saccoloma* C. Chr. Index.—Kabayau to Koung in forest by stream (Tp. 1501, H. 25106, Cl. 27677).

DRYOPTERIS Adanson.

The species of this large genus are arranged below according to the classification in my monograph of the genus,* in which the American species only are dealt with. It appears, however, that most species of the Old World naturally fall under the subgenera there defined, but it seems to me more natural to unite as a special section or subgenus, *Abacopteris,* certain species (chiefly Malayan) which would fall into the subgenus *Cyclosorus,* if this were taken in a wide sense. *Abacopteris* may be said to represent in Asia the American subgenus *Goniopteris.*

Subgenus Lastrea (Bory) emend. C. Chr.

D. gracilescens (Bl.) O. Ktze.—Tenompok, in forest, rhizome short-creeping (H. 25384), Lumu trail, 6000 ft. (Cl., s.n.).

Differs a little from the Javanese type in its long stipe (up to 35 cm.); otherwise typical. All veins are simple, and it differs thereby from *D. Creaghii* (Bak.) C. Chr. from British North Borneo (Kew!), which is very similar to, and in my opinion the same as, *D. Dayi* (Bedd.) C. Chr. from the Peninsula, which again is very doubtfully different from the Sumatran *D. singalanensis* (Bak.) C. Chr. (syn. *D. aureo-viridis* Rosenst. in Fedde Repert. 13: 216. 1914).

D. viscosa (J. Sm.) O. Ktze.—*Nephrodium gymnopodum* Bak. 1894: 252; *Dryopteris* C. Chr., Copel Keys 358.—*D. kinabaluensis* Copel. 1917: 57.—*D. Ridleyi* (Bedd.) C. Chr.—s.l. (Haviland 1486, type of *D. gymnopoda*), Marei Parei ridge (Cl. 11086), Pakka, in open forest on ridge (Tp. 1719, type of *D. kinabaluensis;* H. 25512, Cl. 27971, 29333), Kamborangah (Cl. 28964), Dachang at 10000 ft. (Cl. 29066).

I have tried in vain to distinguish from *D. viscosa* the species quoted as synonyms. *D. viscosa* is widely distributed in the Malayan region and fairly constant as to its most prominent characters: its erect, often much elongated rhizome, dark stipe, dark brown or nearly black colour of the dried frond, and drooping basal pinnæ, by which characters it differs from *D. gracilescens.* The under surface of younger fronds is dotted with brown, gum-like glands which dry out with age and are therefore lacking in old or poisoned fronds.

var. **kamborangana** C. Chr. n. var.—Larger than the type, stipe and rachis grey-brown, the lowest 3 or 4 pairs of pinnæ deflexed, not reduced, to 12 cm. long with

* Vid. Selsk. Skritter VII. 10, 1912 (Part 1) and VIII. 6, 1920 (Part 2).

sometimes deeply serrate segments, both surfaces finely glandular, indusia large, brown, reniform.

Lumu Lumu to Kamborangah, in rather open places in forest (H. 25472), Marei Parei ridge, in shady forest (H. 25609).

This variety looks rather different from the other Kinabalu forms of *D. viscosa*, but it is scarcely a distinct species.

D. badia v.A.v.R. Bull. Jard. bot. Buit. II ser. no. XVI: 9. 1914.—*D. linearis* Copel. 1917: 56.—Marei Parei ridge (Cl. 11067, 11069), Lumu Lumu to Kamborangah (H., s.n.).

The type of *D. linearis* is perfectly identical with a co-type specimen of *D. badia* from Sumatra received from Dr. Matthew. It is closely related to *D. viscosa*, of the same dark colour and with the same pubescence of short brown, crisped hairs on the rachis and costæ above, differing chiefly by the elongated linear-lanceolate fronds with short, somewhat unequal-sided pinnæ. It resembles in habit some forms of *Athyrium macrocarpum*.

D. multisora C. Chr. n. sp.—Speciei præcedente proxime affinis, differt: majore, pinnis æquilatis, linearibus, rachi costisque pilis pallidis, tenuissimis superne hirtis, soris confluentibus, indusiis orbicularibus, peltatis, glandulosis.

KINABALU: Kamborangah, in valley forest (H. 25523, type, in Herb. C. Chr.), Tenompok, in forest (H. 25417, Cl. 28098, 28340), above Pakka (Cl. 27970).

Rhizome stout, erect, the stipe strong, castaneous, furnished with numerous pure-brown thin scales, up to 45 cm. long; lamina linear-lanceolate, 50 by 15 cm., rather thick dark-coloured, bipinnatifid, rachis with some few scales and pubescent above with slender grey hairs. Pinnæ sessile, the lower ones opposite, at distances of 3.5 cm., the basal ones not reduced, not deflexed, 8 cm. long by 1.5 cm. wide, linear-oblong, equal-sided, acuminate, deeply pinnatifid, the segments patent, separated by open, roundish sinuses, oblong, 2.5 mm. wide, entire, the apex roundish-obtuse. Costæ densely strigose above with grey antrorse hairs (some few similar hairs also on the costules and veins above), thinly short-puberulous beneath, the surfaces otherwise glabrous and without glands. Veins simple, about 6–jugate, all fertile. Sori large, at last confluent and filling the whole underside of the segment; indusia brown, orbicular, peltate (at least in no. 25417), glandular; sporangia large, glabrous.

D. supravillosa C. Chr. n.sp.—*D. viscosae* affinis, differt: stipite rachique paleaceis et dense villosis, lamina

superne densissime villosa, inferne ad costulas venasque solum pubescente.

Lumu Lumu to Kamborangah, in mossy ridge forest (H. 25471, type in Herb. C. Chr.).

Rhizome erect, with many ovate brown scales. Stipe light brown, 12-15 cm. long, rather scaly with brown small lanceolate somewhat lacerated scales, and upwards villous with soft pale hairs, rough towards base (from the bases of fallen scales). Lamina lanceolate, about 20 cm. long by 8 cm. wide, firmly herbaceous, olive-brown when dried, bipinnatifid; rachis densely villous and with some few small scales on the lower part, the hairs partly very short, thin, and crisped, partlv long, patent, and rather stiff. Pinnæ 10–15 pairs, alternate, sessile, 5–6 cm. long by 1.3 cm. wide, equal-sided, short-acuminate, the basal ones deflexed and somewhat reduced, segments 12 to 13 pairs, oblique, 3 mm. wide, repand-crenate or faintly dentate, the apex truncate or retuse, the upper side wholly covered with short pale hairs, the costa and midribs only pubescent beneath, the under side glandular. Veins 4–5–jugate, simple. Sori medical; indusia reniform, large, brown, glandular.

This species differs from *D. Robinsoni* (Ridl.) C. Chr. Gard. Bull. S.S. 4: 381. 1929 in having pinnæ twice as wide, lobes much wider, greater hairiness and lack of glands on the upper surface.

D. inconspicua Copel. 1917: 55.—Kiau (Tp. 1543), Gurulau spur (Tp. 1837, 1839), Dallas-Tenompok ridge (Cl. 27603, 27325, 27432, 26893), Tenompok (Cl. 28099).—Dutch Borneo: W. Kutai, Kemul (Endert 3960).

Superficially resembling *D. gracilescens* and forms of *D. viscosa,* but in reality very different, not only by the extremely reduced lower pinnæ (2–3 mm. long only), but also by the anterior basal vein running to the sinus.

GROUP OF D. CRASSIFOLIA (C. Chr. in Gard. Bull. S.S. 4: 381. 1929).

D. crassifolia (Bl.) O. Ktze., C. Chr. l.c. 385.—Tenompok to Lumu Lumu in ridge forest, not very abundant (H. 25440), near Dallas (H. 25254, Cl. 27526).

var. **purpureo-lilacina** C. Chr. n. var.—Sporangiis superficiem totam tegentibus, pulchre purpureo-lilacinis. Penibukan ridge (H. 25599).

I have never seen a fern with the sporangia coloured like this. The sterile leaf does not differ from typical *D. crassifolia,* the rachis of the fertile one is more scaly and the segments are more falcate.

GROUP OF D. SYRMATICA (PTERIDRYS C. Chr.).

An Asiatic group of closely related species which should no doubt be segregated from *Dryopteris,* being totally different from all species of this genus in all characters except in sori; *e.g.*, in colour, texture, pubescence, division, venation etc. In habit some of them resemble species of *Pteris,* of the group of *P. quadriaurita.*

D. microthecia (Fée) C. Chr. Index Suppl. 1913–16: 15. 1917.—*Aspidium microthecium* Fée, 10*e* mém.: 37, t.41 f.2A. 1865.—*Dryopteris Metteniana* Hieron., Christ, C. Chr. Index Suppl. 35. 1913.—*D. subsagenoides* v.A.v.R. Bull. Jard. bot. Buitenz. II Ser. XI: 9. 1913.—*D. Vangenderenstortii* v.A.v.R. l.c. no. XVIII: 11. 1916.—near Dallas (H. 25261, Cl. 27384), near Menetendok, river bank (H. 25584).

Found in several places in Borneo and other Malayan islands. It is very near the genuine *D. syrmatica* (Willd.) O. Ktze, but tolerably distinct in its sessile or only short-stalked pinnæ, the basal ones with one or two prolonged pinnules on the lower side, and by the sori being apical on the veins.

GROUP OF D. SETIGERA.

D. setigera (Bl.) O. Ktze.—below Dallas, open place in old clearing (H. 25369), Kundasang, secondary growth (Cl. 29242), Tenompok (Cl. 29497A).

D. multiseta (Bak.) C. Chr.—Dallas to Tenompok, by path on edge of forest (H. 25294).—Sarawak: Mt. Matang (Hose 98, Hewitt).

This species is also known from Sumatra (Sibolangit, Lörzing 5779). It should be compared with the actual type of *D. setigera.*

On Kinabalu I only saw this species once. More recently I have seen it growing abundantly by roadsides in Sumatra at about 2000 feet or more above sea level. It may reach a very large size, with stipes a metre long and fronds of the same length. The stipes of old plants are often reddish. It is a very handsome fern, and very distinct from the much smaller *D. setigera;* both are ferns of rather open places, not of the shady forest. *D. multiseta* is now growing well in cultivation in Singapore, and it is surprising that it has not been found growing wild in the Peninsula.

GROUP OF D. IMMERSA.

D. immersa (Bl.) O. Ktze.—Kundasan, edge of jungle (Cl. 29765), Dallas-Tenompok ridge, by path (Cl. 27739, 27523), Tenompok (Cl. 26834).

This species was common beside the bridle path, but I saw no fertile plants during my visit.

SUBGENUS CYCLOSORUS (Link) emend. C. CHR.

D. contigua Rosenst. Meded. Rijks Herb. Leiden no. 31: 8. 1917.—Koung to Lobang (Tp. 1900), Kabayau to Koung (Cl. 27692), in low altitude without locality (H. 25727), Kundasang (Cl. 29238), Dallas (Cl. 27739, 27475).—Sandakan (Elmer 20383).—Sarawak: Mt. pok Cl. 28233), Silau basin at 6000 ft. on rocks (Cl. Poi (Mjöberg).

Very briefly described from a specimen from Borneo, coll. Teuscher. It falls under *D. parasitica* sens lat., but is no doubt quite different from the typical form of that species, though resembling it in pubescence and venation, differing chiefly by its long narrow lamina on a very long stipe and by the lower 2 or 3 pairs of pinnæ being more or less abbreviated. The rhizome is short, erect. In the narrower pinnæ (about 1 cm. wide) the basal veins are not always united, but connivent to the sinus.

D. parasitica (L.) O. Ktze.—*Aspidium tectum* Wall.—s.l. (Tp. 1513), near Menetendok, by river side (H. 25574), Tenompok bridle path (Cl. 27469).—Rhizome creeping.

D. subpubescens (Bl.) C. Chr. Gard. Bull. S.S. 4: 390. 1929.—Koung (H. 25121), near Menetendok, in open forest near stream (H. 25575, glabrous form).

D. heterocarpa (Bl.) O. Ktze.—Lobang (Tp. 1788), Tenom-29054, 29050), Marei Parei (H. 25600?).

H. 25600 is an aberrant specimen with unusually long spreading hairs on costæ on veins beneath.

D. porphyricola Copel. Phil. Journ. Sci. 7C: 60. 1912.—Tenompok (H. 25389, Cl. 27190, 27371, 28282, 28456).

A species similar to *D. stipellata* (Bl.) in size, division, the presence of large ærophores, and in the antrorsely strigose ribs of both surfaces, but differing in the upper surface being densely strigose throughout with antrorse, adpressed grey hairs, and in the under surface being densely glandular with globose yellow glands. In the last-named character it agrees with *D. heterocarpa,* but *D. heterocarpa* is smaller, has the hairs beneath crisped-patent and lacks the large ærophores. *D. porphyricola* is known from Sarawak (Bau, Brooks 12; Mt. Merinjak, Native Coll. 180), and I have referred to it with some doubt Elmer 22075 from Mt. Pinatubo, Luzon. The Kinabalu specimens differ a little from the type in the abortive pinnæ being extremely small. Gibbs 4035, referred by Gepp to *D. stipellata,* may belong here.

H. 25389 when fresh had the young fronds covered with mucilage (through which the ærophores projected) like those of *D. stipellata;* this character is not reported for the other specimens, but their ærophores are conspicuous. In the Peninsula, *D. heterocarpa* is very variable in the extent of hairiness of the upper surface and of the costæ beneath, and there may be similar variation in *D. porhyricola.* The study of further material may indicate that *D. porphyricola* should be regarded as a variety of *D. stipellata.* (R.E.H.).

D. lobangensis C. Chr. n. sp.—Rhizomate repente, sparse paleaceo. Stipitibus remotis, ad 40 cm. longis, glabris, nitidis, parte dimidia superiore auriculis pluribus minimis instructis. Lamina late lanceolata, 25 cm. longa, medio 10–13 cm. lata, chartacea, bipinnatifida, apice pinnatifida, basi subito in auriculas contracta, rachi superne dense antrorsim strigosa, inferne angulari, glabra. Pinnis sessilibus, alternis, apice integro breve acuminatis, inferioribus 2–3–jugis deflexis, 2–3 cm. inter se remotis, 5 cm. longis, 12 mm. latis, paulo supra medium pinnatifidis, segmentis densis, obliquis, obtusis vel subacutis, basi 3 mm. latis, basalibus vix acutis, costis ut rachi superne strigosis, inferne glabris sed cum venis glandulis luteis sat dense glandulosis, marginibus sparse ciliatis. Venis simplicibus, 5–jugis, basalibus unitis, secundi paris ad sinum conniventibus. Soris medialibus, indusiis parvis, cito delapsis, sporangiis glabris.

KINABALU: Lobang (Cl. 10728, type in Herb. Copeland).

Differs from *D. heterocarpa* and related species by the chartaceous texture, deflexed lower pinnæ, the less deeply cut pinnæ with oblique segments, and by the glabrous but glandular under side.

D. arida (Don.) O. Ktze.—Kiau (Tp. 1560).

D. callosa (Bl.) C. Chr.—Lobang (Cl. 10347).—Typical, new to Borneo.

D. lithophylla Copel. 1917: 57.—Marei Parei ridge, exposed place (Tp. 1850, H. 25601).

An extremely coriaceous plant with ærophores along the stipe to the base, the young fronds covered with mucilage.

D. unita (L.) O. Ktze.—Near Dallas, wet grassy places by path, abundant (H. 25263, Cl. 26928), Kundasang, edge of secondary growth (Cl. 29240).

D. oosora (Bak.) C. Chr.—Kudat, by stream (H. 25102).

This is technically a *Mesochlaena* because of its oblong indusia, but as to all other characters it so closely resembles *D. unita* that it seems unnatural to segregate it from

Dryopteris. It further differs from *D. unita* by its thinner texture, broader segments and two pairs of united veins, short-creeping rhizome, the stipe with 2–4 pairs of small auricles below the lowest developed pinnæ, the pinnæ 20 cm. long by 2 cm. wide, incised half-way, the whole frond rather densely but shortly grey-pubescent. The species was known previously from Pulo Gaya, B.N. Borneo, only (Hose 334).

D. megaphylla (Mett.) C. Chr.—Kiau (Tp. 1531), Dallas (Cl. 27288, 26766, 27317). A form with narrow pinnæ, approaching *D. arbuscula* (W.) O.K.

D. truncata (Poir.?) O. Ktze.—Kiau (Cl. 10233), near Dallas, frequent in forest (H. 25260, Cl. 27541), Tenompok (Cl. 28646, 29450).

D. Toppingii Copel. 1917: 56. C. Chr., Gard. Bull. S.S. 4: 391.—Lobang (Tp. 1766), Tenompok (H. 25395, Cl. 28082), Dallas-Tenompok ridge Cl. 27543, 27729).

A species of doubtful relationship. In colour, texture, cutting and lack of auriculiform pinnæ it resembles *D. crassifolia* rather than the foregoing species, but it agrees with them in venation, about 4 pairs of veins being united.

D. ferox (Bl.) O. Ktze.—Silau basin, among rocks in jungle, at 7000 ft. (Cl. 29062).

D. baramensis C. Chr. n. sp.—*Cyclosorus?* Rhizomate breve suberecto. Stipite ad 35 cm. longo, brunneo, minutissime puberulo, ad basin solum parce paleaceo, ærophoris tuberculiformibus, 5–6–jugis, remotis (pinnis abortivis) instructis. Lamina ovato-lanceolata, ad 50 cm. longa, 20–40 cm. lata, chartacea, sicca brunnea, bipinnatifida, rachi subpuberula, mox glabra. Pinnis ca. 15–jugis, oppositis, 3–4 cm. inter se remotis, breve petiolulatis, maximis 25 cm. longis, 4 cm. latis, infimis evolutis vix reductis, subito in apicem acuminatum, subintegrum contractis, ad alam 3 mm. latam pinnatifidis. Segmentis obliquis, lateribus parallelis integerrimis, apice postice rotundatis antice subacutis, 3–4 mm. latis, basalibus pinnarum inferiorum multo abbreviatis, superiorum æqualibus; pagina superiore pilis griseis appressis ubique sat dense strigosa, inferiore ad costas venasque antrorsim strigosa, inter venas minutissime glandulosa. Venis simplicibus, ca 10–jugis, infimi paris unitis. Soris supramedialibus, sæpe uno in vena basali anteriore et 3–5–jugis in venis superioribus; indusiis persistentibus, reniformibus, puberulis.

SARAWAK: Baram valley, Lio Matu, 3–4000 ft. alt., common in a thick forest (Mjöberg, 1923, type in herb. C. Chr.). Kinabalu: Tenompok, frequent in forest (H. 25385, Cl. 27938, 26932, 30456, 27601, 28453 part).

Nearly related to *D. porphyricola* Copel, but the lower pinnæ reduced to tuberculiform glands (ærophores), pinnæ much deeper cut, with only one pair of united veins, the lower ones narrowed towards their base. Both species belong to a small group of Malayan species, the natural position of which is still uncertain to me. In colour and texture they are quite different from the bipinnatifid species of *Cyclosorus*, resembling more nearly *D. crassifolia* and its relatives, but the venation and presence of abortive pinnæ show that they cannot properly be associated with *D. crassifolia*. The specimens from Kinabalu are on the whole typical, but differ in usually having a glabrous upper surface and no glands beneath; they probably represent a local variety. Some specimens have hairs on the upper surface towards the costæ, the segments being glabrous.

Section Abacopteris (Fée).

Under this name I provisionally unite a considerable number of Malayan species which seem to be quite different from the bipinnatifid species of the subgenus *Cyclosorus*, so different that they might naturally be segregated from it to form a new subgenus. The species concerned are certainly very different from each other in some important characters, but very uniform in others, especially colour, texture, pubescence, and the fronds at best simply pinnate. The fronds are quite entire in a few species, but in most they are pinnate with entire or slightly lobed pinnæ with many pairs of often alternately united veins, their under side often characteristically verrucose. The species may be divided into groups, which however run into one another. A long series of small, closely related species are marked by dimorphous fronds, the fertile ones being much contracted with confluent sori. (*Haplodictyum* Presl, type *D. acrostichoides* (J. Sm.) v.A.v.R.) ; this group runs gradually through several intermediate forms into the next (*Abacopteris* Fée, type *D. lineata* (Bl.) C. Chr.), to which I refer larger species with conform fronds, which may be simple, or pinnate with few pairs of pinnæ; from these species we come gradually to the big ones, such as *D. urophylla* (Wall.) C. Chr., which form a third group, in which I include the Asiatic species of *Meniscium*. *Stegnogramma* Bl. is an offshoot of the last group.

To this "subgenus" belong several Bornean species, some of which were originally described as species of *Acrostichum* by Baker, and were transferred in my Index to *Leptochilus (L. exsculptus, L. oligodictyus)*. From Kinabalu the following species have been collected.

D. Hosei (Bak.) C. Chr.—Kabayau to Koung, rocky stream margin (Cl. 27663).

D. exsculpta (Bak.) C. Chr. in Copel. Phil. Journ. Sci. 37: 310. 1928. *Leptochilus* C. Chr. Index.—*Dryopteris brevipinna* C. Chr. Index (*Meniscium stenophyllum* Bak.)—Penibukan ridge (H., s.n.). Other collections at Singapore are: Bettotan, near Sandakan (Kloss 19036). Sarawak: s.l. (Hose 20, 244).

The Kinabalu collection differs somewhat from the Sandakan plant, having more coriaceous and less strongly toothed pinnæ. The pinnæ are however distinctly toothed, and in shape and size agree with *D. exsculpta* rather than with *D. tenompokensis* (*see* below); they also agree with Kloss's specimen in having strongly setose indusia and sporangia. (R.E.H.).

D. tenompokensis C. Chr. n. sp.—Foliis dimorphis *D. exsculptae* (Bak.) C. Chr. et *D. Hosei* (Bak.) C. Chr. similis, differt a priori: pinnis integerrimis; a posteriore: pinnis basi truncatis vel subcordatis, rachin subamplectentibus.

KINABALU: Tenompok, on rocks by stream in forest (H. 25388, type in Herb. C. Chr., Cl. 27622).

Rhizome short-creeping, the leaves subfasciculated, dimorphous. Sterile fronds to about 50 cm. long (including the stipe 20 cm.), 10–17 cm. wide, the pinnæ up to 8.5 cm. long by 2 cm. wide, quite entire, short-acuminate to rather long-acuminate, the basal ones deflexed, not reduced, the base equally truncate or subcordate, the larger ones with an obtuse auricle above, more or less embracing the rachis, with a distinct tuberculiform ærophore below; veins in 4–5 alternately united pairs, raised below, costæ shortly strigose above, the margins ciliate, the surfaces glabrous, the under side verrucose; texture herbaceous, colour dark green. Stipe of the fertile leaf 30–40 cm. long, the blade 20–30 cm., the largest pinnæ 3 cm. by 6–8 mm., the under side wholly covered with the confluent sori; sporangia light brown, without the setæ which are a frequent character in this group of ferns; indusia small, glabrous, fugacious.

This is as distinct as many others of the group. Its nearest ally is no doubt *D. exsculpta* (*see* above), which differs from our species by shorter, obtuse and crenate-lobate pinnæ and setose indusia and sporangia. *D. Hosei* differs chiefly by the decidedly unequal-sided base of the pinnæ. In the shape of the pinnæ *D. tenompokensis* also closely resembles *D. firmula* (*see* below) but this is not dimorphous. Cl. 27622 is larger than the type, having sterile pinnæ 9 by 2.5 cm.

D. labuanensis C. Chr.—Dallas, rocky stream margin (Cl. 30458). This specimen has setose sporangia and indusia.

D. mirabilis Copel. Phil. Journ. Sci. 6C: 137, pl. 19. 1911.—near Dallas, on rocks by stream in forest (H. 25147).

The type from Sarawak (Bidi, Brooks!) is a form with only one pair of lateral pinnæ, and I believe that *D. holophylla* (Bak.) C. Chr. from Niah (Hose 242, Kew) and Mt. Matang (Matthew), which has undivided fronds, probably represents the same species. The Kinabalu fern is pinnate with 4 pairs of pinnæ, the sterile ones 3 cm., the fertile less than 2 cm. wide. The species has also been collected in the Malay Peninsula: Kedah, Pulau Langkawi (Holttum 17436, with 1 to 3 pairs of pinnæ) and a much smaller form from Pahang, Bukit Senai (Henderson 19437), with 1 or 2 pairs of small lateral pinnæ below the large terminal pinna.

Small plants similar to Henderson's 19437, when brought into cultivation in Singapore, have grown into the typical larger form. The small size seems to be characteristic of plants growing in somewhat exposed situations on river banks. Such plants are common by some of the Pahang rivers, and have been collected also in Perak. (R.E.H.).

D. firmula (Bak.) C. Chr.—near Dallas, on ground near stream in forest (H. 25144, Cl. 26923, 27430), in moist shady forest near Dahobang river (H. 25596). Sarawak: Mt. Dulit (Hose 295, Mjöberg).

The Kinabalu specimens are large, but otherwise typical. Leaves uniform, almost entirely glabrous; pinnæ about 5 pairs, 12–15 by 3 cm., the lower ones cuneate at base, the upper rounded below and truncate and auricled above, entire; veins 5–6 pairs, sori near the main veins, exindusiate; sporangia not setose, but bearing red glands close to the annulus; ærophores present. Intermediate between *D. lineata* and *D. urophylla*.

D. urophylla (Wall.) C. Chr. var. **nitida** Holttum n. var.—a speciei typica differt: venulis valde obliquis, pagina superiore glaberrima, nitente, non pustulosa.

Menetendok, in secondary forest, abundant (H. 25592).

This variety is very similar in general form and habit to *D. urophylla* as found in the Malay Peninsula (type from Penang), but differs very strikingly in the two characters noted in the above diagnosis. The difference seems to me hardly sufficient to warrant a specific separation. The veins are much more oblique than in typical *D. urophylla*, and this gives them a closer appearance, though they are actually not more numerous; they are doubly curved into a long

slender S, in the same way as those of the typical form, but with the curvature a little more pronounced. The upper surface is usually very smooth and shining, and is not verrucose. All Bornean specimens in the *D. urophylla* cover in the Singapore herbarium belong to this variety, and also a specimen from Tawitawi island (Philippines), which is not far from the coast of B.N. Borneo. The variety probably represents the Bornean form of the species. As in Peninsula specimens, var. *nitida* varies somewhat in the cutting of the margins of the pinnæ, from repand-crenate to rather deeply and coarsely toothed; the bases of the pinnæ are usually cuneate, but may be rather broadly rounded. The fronds dry green or somewhat brownish, but not red.

This variety is very abundant in the low country round Kinabalu, in rather open grassy places by the bridle paths, often rather yellowish where most exposed, and in the secondary forest which springs up on the abandoned rice ladangs. In this habitat it differs from *D. urophylla* in the Peninsula, which is not usually found except in rather shady primitive forest. Other Bornean specimens are: B.N. Borneo: Sungei Bakong (Teruya, March 1932), Sandakan (Elmer 20306). Sarawak: s.l. (Bishop Hose, 1891), Lawas (Native collector 30, distr. E. D. Merrill). Dutch Borneo: W. Kœtai, Lahœm, 40 m. (Endert 1853, distr. as *D. cuspidata*). Philippines: Tawitawi, Sulu Prov. (Ramos & Edano, Bureau of Science no. 44171, distr. as *D. moulmeinensis*).

Subgenus Stegnogramma (Bl.).

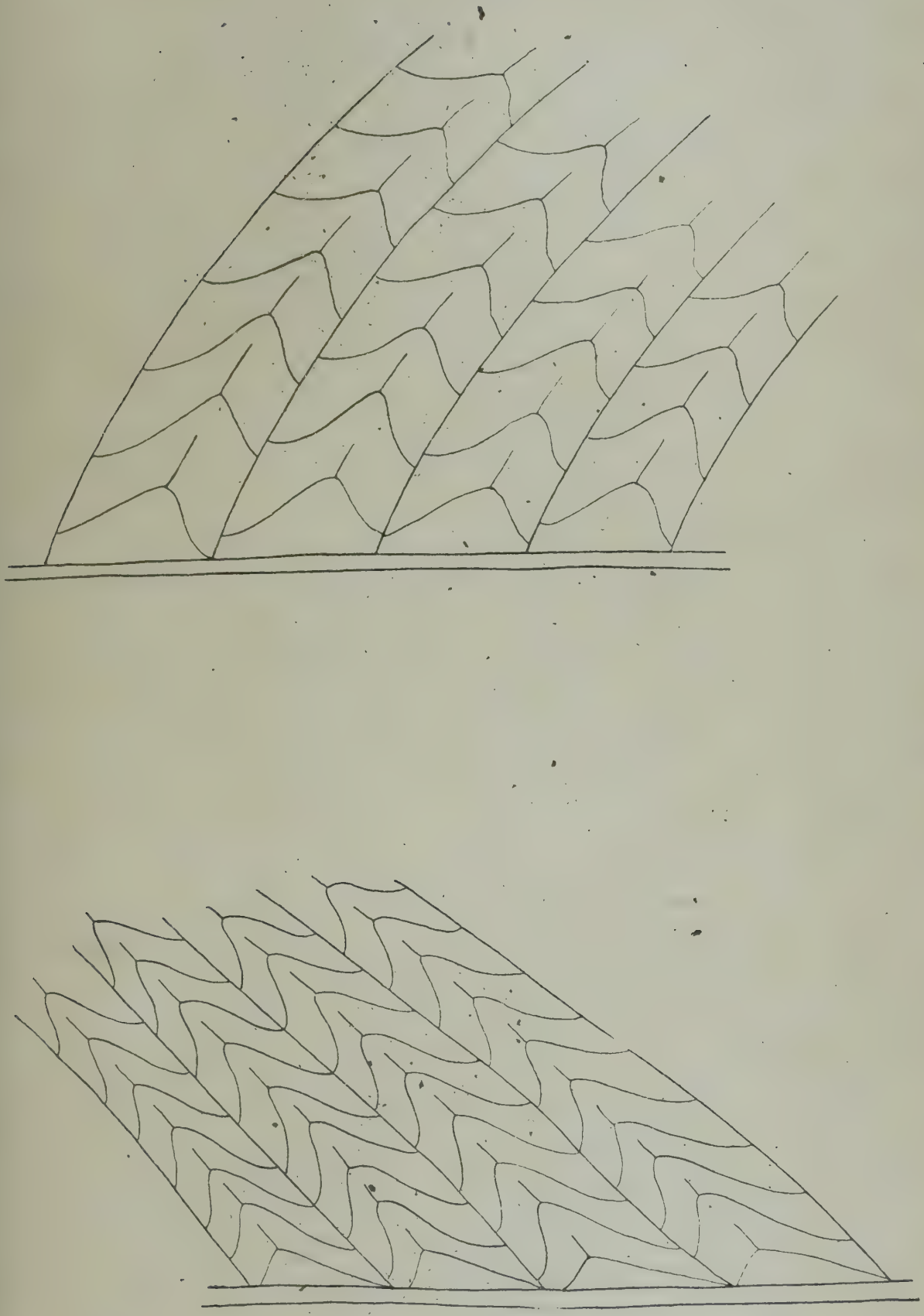
D. stegnogramme (Bl.) C. Chr.—Kamborangah, in wet forest near river (H. 25538).

This is the typical form, widely different from the Himalayan and south Chinese fern usually but wrongly referred to the same species.

Subgenus Eudryopteris.

D. hirtipes (Bl.) O. Ktze.—Lobang (Tp. 1769, H. 25557), Tenompok, on rocks by stream in forest (H. 25390, Cl. 29416, 28205). Locally abundant. H. 25557 has conspicuous indusia, but no indusia can be found on the Tenompok specimens, which thus agree with the Himalayan-Chinese *Phegopteris Scottii* Bedd.

D. paleacea (Sw.) C. Chr. Amer. Fern. Journ. 1: 94. 1911.—*D. filix mas* subsp. *patentissima* (Wall.) C. Chr. Index.—near Pakka, in forest near stream, not abundant (H. 25514, Cl. 28973).



DRYOPTERIS UROPHYLLA, venation, × 3. Above, typical form, from Penang. Below, var. nitida.

The first specimen of this species I have seen from Borneo. It agrees closely with the Himalayan *Aspidium patentissimum* Wall., which I can distinguish at best as a variety from the South American *D. paleacea*. This is a tropical subspecies of the northern *D. filix mas* and is often so named; it occurs in very scattered localities on high mountains in tropical America and Asia, the Hawaiian islands and Madagascar.

D. sparsa (Ham.) O. Ktze.—near Menetendok, in forest near river (H. 25576), Tenompok (Cl. 27905, 28117), Lumu trail (Cl. 28384), Falls above Lumu (Cl. 29940). New to Kinabalu, rare in Borneo.

The specimens are all terrestrial, and some are much dwarfed.

D. polita Rosenst., Fedde Repert. 13: 218. 1914.—Tenompok (H. 25387, Cl. 27976, 28680), Silau basin, rocky place near stream at 6000 ft. (Cl. 29057).

This species is allied to *D. sparsa,* with which it has probably been confused by some authors; it is however clearly distinct, and except for its eudryopteroid venation it resembles rather *D. syrmatica* (Pteridrys) in some important characters, *e.g.* the grey-green colour, the wholly glabrous and broadly deltoid lamina with long-stalked pinnæ. It further differs from *D. sparsa* by its entire or bluntly crenate, not sharp toothed segments. In addition to the type locality in Sumatra, the species has been found in the Malay Peninsula at Cameron's Highlands, alt.4400 ft. (Holttum 23451), and at Tonkin; it evidently has a wide distribution in the Malayan region.

D. subarborea (Bak.) C. Chr.—*D. tabacicoma* v.A.v.R. Bull. Jard. bot. Buit. II ser. XVI: 11. 1914; Handb. Suppl. 174.—Lumu Lumu to Kamborangah, in more open ridge forest (H. 25456), near Kamborangah, in fern thicket by edge of river (H. 25531), Silau basin at 7000 ft. (Cl. 29696, 29875), without locality (Cl. 29710).

Like most large dissected ferns, this, the biggest species of the subgenus, is variable as to the degree of division. No. 25531 is the typical form, matching the type from Niah, Sarawak (Hose 174), with the tertiary segments all broadly adnate and decurrent at base and shallowly dentate only (the basal ones excepted). Stipe densely chaffy with linear, brown or fuscous scales. *D. tabacicoma* is the same. No. 25456 is smaller but more dissected, most tertiary pinnules being free at base, sessile and rather deeply lobed; the scales on the stipe are much narrower.

Subgenus Ctenitis C. Chr.

D. adnata (Bl.) v.A.v.R. Handb. Suppl. 501. 1917. *Aspidium adnatum* Bl. Enum. 162.—*D. filix mas* Copel.

Keys 358.—*Polystichum truncatulum* v.A.v.R. Bull. Jard. bot. Buit. II Ser. XVI: 60, pl. 8. 1914.—Pakka to Lobang (Cl. 10723), at 11500 ft., in rock crevices, in bushy thicket on granite core of mountain (H.

This very distinct species has been much misunderstood by authors who have almost all (my Index included) referred it to *D. filix mas*. It certainly resembles that species very much in general habit, but the two species are in my opinion very remotely related, while on the other hand *D. adnata* is closely allied to *D. apiciflora* (Wall.) O. Ktze. Both the two last named species differ from *D. filix mas* and all other species of *Eudryopteris* by the costæ being rusty tomentose above with intestiniform hairs, by which character they agree with all species of the subgenus *Ctenitis*, and I place them therefore tentatively in this, though it must be admitted that they are rather isolated species. The frond of *D. adnata* is bipinnatifid, and like other members of the subgenus of a characteristic brown colour when dried; the stipe, rachis and costæ beneath are rather densely chaffy with reddish brown, ovate-acuminate entire scales, the rectangular segments crenately lobed or subentire (in this respect also wholly different from *D. filix mas* and its relatives, the segments of which are sharply dentate). The sori are medial, not confined to the distal part of the segment as in *D. apiciflora*, furnished with rather small, subpersistent, reniform glabrous indusia. According to Copeland, the same form as found on Kinabalu occurs also in the Philippines; the type is from Java.

D. dissecta (Forst.) O. Ktze.—Near Menetendok, on rocks by river, pendulous (H. 25571).

This is exactly the same as the Philippine fern first described as *Nephrodium membranifolium* Presl. (t. orig. in Herb. Presl), which has been badly confounded with a very similar fern with pleocnemioid venation (*Aspidium membranifolium* Index, now *Tectaria fuscipes* (Wall.) C. Chr., Contrib. U.S. Nat. Herb. 26: 290. 1931). Two questions remain to be settled: (1) whether the forms with free and anastomosing veins and now placed in two genera are really specifically different, and (2) whether the true Polynesian *Polypodium dissectum* is the same as *N. membranifolium* Pr. In every case these forms of subcompound species prove that we find a gradual transition between the subgenus *Ctenitis* and *Tectaria*, group of *T. cicutaria*.

D. aciculata (Bak.) C. Chr.—Tenompok, in forest near stream, stock short decumbent (H. 25253), Dallas-Tenompok ridge (Cl. 26846).

Rather larger than the type from Sarawak (Hose 86), but I have exactly the same from Mt. Merinjak, Sarawak. It is surprisingly like *Tectaria Leuzeana,* but much more scaly and the veins free, and is another instance of the close relationship of *Ctenitis* and some species of *Tectaria.* It is the largest species of a group of Asiatic species, *e.g. D. vilis* (Kze.) C. Chr. (*Aspidium intermedium* Bl.), *D. rhodolepis* (Cl.) C. Chr.

Species of uncertain relationship.

Dryopteris Hasseltii (Bl.) C. Chr.—*D. laserpitiifolia* (Scort.) C. Chr.—Tenompok, in forest (Cl. 28598).

This belongs to a small group of Asiatic species, the position of which is still uncertain. Some of them, *e.g. D. obovata,* approach *Athyrium.* I have hitherto placed them in the subgenus *Polystichopsis,* but they do not really belong there. *D. laserpitiifolia* from the Malay Peninsula is quite identical with *D. Hasseltii;* it occurs also on the mountains of Sumatra.

D. Boryana (Willd.) C. Chr.—Near Menetendok, among rocks (H. 25583).

New to Borneo. This species, together with one or two near relatives, is placed by all authors in *Dryopteris,* and for some time I considered it a rather isolated species of the subgenus *Ctenitis.* Recent studies, chiefly of Chinese and African species, have convinced me, however, that it is not a *Dryopteris* at all, but a near ally of some decompound species of *Athyrium, e.g. A. Atkinsoni* Bedd. Whether it may be referred naturally to that genus, or eventually to a new genus, must be decided by further studies.

I cannot distinguish *D. Kingii* (Bedd.) C. Chr., from Perak (Kunstler 2250), from *D. Boryana.*

DIDYMOCHLÆNA Desvaux.

D. truncatula (Sw.) J. Sm.—s.l. (Burbidge), Kiau (Gibbs 4098), Dallas-Tenompok ridge (Cl. 30455), near Menetendok (H., s.n., Cl. 29630). Nowhere on Kinabalu an abundant species.

MESOCHLÆNA R. Brown.

M. Toppingii Copel. 1917: 57.—Koung to Kabayau (Tp. 1902), near Dallas on wet bank near stream (H. 25130, Cl. 27458), Dallas-Tenompok ridge (Cl. 26908).

Scarcely more than a local variety of *M. polycarpa,* of which I have a specimen from Sumatra with many similarly much reduced sagittate pinnæ.

POLYSTICHUM Roth.

Group of P. aculeatum.

In his Keys, p. 366, Copeland referred three distinct ferns to the comprehensive *P. aculeatum,* being unable to identify them. The agreement of his specimens with those collected by Mr. Holttum enables me to distinguish the following four species.

P. kinabaluense C. Chr. n. sp.—Rhizomate decumbente vel breve repente, crasso, paleis rufis, ovatis lanceolatisve, fimbriatis dense vestito. Stipitibus 10–20 cm. longis, paleis rufis, lanceolatis, longe fimbriatis et aliis filiformibus ornatis, denique denudatis. Lamina deltoideo-lanceolata, 15–20 cm. longa, basi 4–8 cm. lata, acuminata, rigide coriacea, bipinnata; rachi paleis rufis fimbriatis, aliis latis aliis angustissimis dense vestita. Pinnis basalibus maximis, 3–4 cm. longis, 1 cm. latis, acuminatis, omnibus parte dimidia inferiore pinnatis, superiore pinnatifidis, pinnulis liberis 6–8–jugis, trapezoideis, 5 mm. longis, 3 mm. latis, subpetiolatis, utrinque pungenti-dentatis, apice longe spinescente, dentibus rigidis; costis utrinque laxe paleaceis, serius nudis, pagina inferiore paleis filiformibus sparse conspersa, cito nuda. Soris medialibus, sat parvis, indusiis non visis.

Kinabalu: Pakka to Low's Peak (Cl. 10648, type, Herb. Bur. Sci. Manila, Herb. Kew.), at about 12000 ft., in crevice, under overhanging rock (H. 25490, exactly typical), below Kamborangah ? (Cl. 27968). Plate 52.

A high-alpine species of the *aculeatum*-complex, characterised by the long stipe and small subdeltoid bipinnate lamina of rigid texture. Clemens 27968 has rather larger fronds and shorter stipes than the other specimens.

P. obtusum J. Sm.—Below Kamborangah, on steep rocky slope in forest (H. 25714, 25534, Cl. 27948?), falls above Lumu (Cl. 29937).

Differs from the former species by its much large size, the pinnæ pinnate nearly to the tip, the pinnules subentire with few or no aristate teeth below the apex. No. 25534, collected near the river, is larger and thinner in texture than no. 25714, from a dry rocky place.

var. **densum** v.A.v.R. Bull. Jard. bot. Buit. II ser. I: 12. 1911. XI: t. 6. 1913.—Silau basin, jungle ridges at 7–8000 ft. (Cl. 29629), Kamborangah (Holttum 25525bis).

The specimens quoted are very large, agreeing in size with the variety described by v.A.v.R. The pinnules are deeply serrately lobed, the lobes not aristate. The basal

pinnules of the lower pinnæ have free auricles. The scales are exactly as in the typical form of the species.

P. Holttumii C. Chr. n. sp.—Rhizomate ? (verisimiliter erecto), stipitibus 60 cm. longis, densissime paleaceis; paleis rufis concoloribus, mollibus, aliis ovatis 5–6 mm. latis tenuiter ciliatis, aliis lanceolatis in apicem longissimum filiformem contortum attenuatis, aliis parvis numerosioribus dense ciliatis crispatis, stipitem dense tegentibus. Lamina lanceolata, ad 60 cm. longa, 25 cm. lata, versus basin augustata, herbacea, subtripinnata; rachi ut stipite dense paleacea. Pinnis alternis, sessilibus, linearibus, acuminatis, maximis 14 cm. longis, 1.5 cm. latis, inferioribus sensim brevioribus (infimis 7–8 cm. longis). Pinnulis densis, ad 25–jugis, parum obliquis, 8 mm. longis, basi 4 mm. latis, basali acroscopica producta, postice cuneatis antice subauriculatis, apice obtusis vel subacutis, raro breve mucronatis, margine incrassatis sine dentibus, basi auricula obovata, integra, libera instructa, sursum lobatis, lobis 2–3–jugis, obtusis. Costis inferne ut rachi dense rufo-paleaceis, superne parce fibrillosis. Soris parvis, medialibus, indusiis rufis, glabris, subpersistentibus.

KINABALU: Pakka (H. 25513, type in Herb. C. Chr., Cl. 27972; also probably Cl. 27973 & 28971, small immature plants). Plate 53.

A very beautiful fern, abundantly different from the preceding species, but near the more dissected forms of the European *P. setiferum* (Forsk.) Woynar (*P. aculeatum angulare* auctt.), but much more scaly and without aristate teeth.

P. gemmiparum C. Chr. n. sp.—Rhizomate oblique erecto. Stipitibus ad 30 cm. longis, stramineis, dense paleaceis, serius delapsis denudatis muricatisque; paleis mollibus, rufo-brunneis, concoloribus, inferioribus ovatis superioribus lanceolatis et filiformibus, omnibus parce fimbriatis et in apicem filiformem desinentibus. Lamina e basi usque ad 25 cm. lata, versus apicem gradatim attenuata, 40–50 cm. longa, 5–10 cm. infra apicem gemmam rufo-squamosam ad rachin nascente, utrinque pallide viridi, papyracea, bipinnata vel foliis minoribus bipinnatifidis; rachi straminea, ut stipite paleacea, paleis plerisque filiformibus, læte brunneis. Pinnis alternis, subfalcatis, inferioribus maximis ad 12 cm. longis, breve petiolatis, ceteris sensim brevioribus, sessilibus, omnibus basi postice cuneatis, antice truncatis et breve auriculatis, apice argute acutis rarius acuminatis, maximis 3 cm. latis, parte inferiore pinnatis sursum profunde pinnatifidis, medialibus

lobatis, superioribus subintegris. Pinnulis laciniisque valde obliquis, trapezioideo-ovatis, postice decurrente antice rotundato-excisis, rarius subauriculatis, maximis 5–6 mm. latis (basali acroscopica majori), contiguis, integris vel majoribus 1–2 dentibus brevibus instructis, apice breve aristatis. Pagina superiore nuda, inferiore paleis læte brunneis, lanceolatis, fimbriatis ubique, ad costas densius conspersa. Soris parvis, medialibus, indusiis pallidis, glabris, mox delapsis.

KINABALU: near Lobang, on rocks by stream (H. 25561, type in Herb. C. Chr., Cl. 10353), Tenompok (H. 25394, Cl. 28094). Plate 54.

This species is closely allied to *P. prolificans* v.A.v.R. (Bull. Jard. Bot. Buitenz. III Ser. vol. 2: 170. 1920) from north Sumatra and the Malay Peninsula (Penang and Perak only),but differs by its considerably smaller size, the pinnules never deeply divided, and the concolorous scales. (R.E.H.).

P. gemmiparum also closely resembles *P. eximium* (Mett.) C. Chr. (*Aspidium* Mett.), from Ceylon (Thwaites 3275) and many other localities, in colour and shape of segments, but it is smaller, less divided, and constantly gemmiferous, the sori not inframedial, indusiate. In general habit it is not unlike the Brazilian *P. platyphyllum* (Sw.) Pr.

This fine species I originally described after Clemens 10353 (Herb. Bur. Sci. Manila), but the description above is taken from Holttum's larger specimens, and his no. 25561 must therefore be held as the type.

P. puncticulatum v.A.v.R. Bull. Jard. bot. Buitenz. III ser. 2: 171. 1920.—Near Tenompok, on exposed bank by path (H. 25359), Tenompok (Cl. 26641, 27328, 28032, 28102),Koung-Kabayau, steep hillside above river, at 100 ft., abundant (Cl. 27660).

Holttum's plant is an extremely coriaceous, small form, in habit and size much resembling *P. varium* (L.) Pr., but lacking bullate scales and as to other characters agreeing better with *P. puncticulatum*. Rhizome short, erect; the lamina deltoid, 25 cm. long by 15 cm. wide, bipinnate, only the slightly prolonged lower pinnules of the basal pinnæ pinnatifid; leaf-tissue between the veins vaulted, the under side being consequently furrowed; sori supramedial, rather large, apparently exindusiate, but the indusia perhaps all fallen. The specimen represents apparently an unusually small and coriaceous form of the species (possibly in part owing to an exposed habitat), of which more typical examples are: Matang, Sarawak (Hose, at Kew); Gunong Tahan, Pahang (Holttum 20779).

Clemens 27660, from a lower altitude, is larger than H. 25359, and less coriaceous. In size and cutting it agrees very nearly with the type of *P. puncticulatum,* differing in having the teeth of the pinnules more acute, in some cases the apices almost aristate. There is some variation in the teeth of other specimens. (R.E.H.).

This species, originally described from Sumatra, is now known to occur in the Malay Peninsula and Borneo. It is closely allied to *P. speciosum* (Don.) J. Sm., and Peninsula specimens were formerly referred to that species.

P. aristatum (Forst.) Pr.—Gurulau spur (Gibbs 2980), Kamborangah to Pakka (Gibbs 4222), near Lobang, rocky ground near river, in forest (H. 25566).

Both Miss Gibbs's specimens were named by Gepp and I have not seen them; they may belong either to the former or to the following species.

P. carvifolium (Kunze) C. Chr.—Marei Parei ridge (Cl. 11037), Kamborangah abundant on ground in forest (H. 25525, Cl. 28976), Tenompok to Lumu Lumu (H. 25439 ?, Cl. 27969, 29974), Silau basin at 9,000 ft. (Cl. 29053).

Not quite like the Indian type, especially differing in the broader and dark brown rhizome scales. It is much more divided than *P. aristatum,* being 4-pinnate.

The three last-mentioned species would perhaps be better referred to *Dryopteris* subgenus *Polystichopsis.*

CYCLOPELTIS J. SMITH.

C. Presliana (J. Sm.) Berk.—Near Koung, on shady rocks by bridle path, and by streams (H. 25626).

HETEROGONIUM PRESL.

An excellent genus, restored by Copeland in 1929 (Univ. Cal. Publ Bot. 16: 61), much more closely related to the group of *Dryopteris sagenoides* (which should be segregated from *Dryopteris*) than to any species of *Tectaria,* to which genus it has hitherto been referred. The two known species occur in Borneo. The more widely distributed type-species is *H. aspidioides* Presl (synonym: *Aspidium ambiguum* Diels, Index), which has been recently collected near Sandakan by Boden Kloss (no. 19034); its veins are free outside the costal and costular areoles. The other species has been found on Kinabalu, as described below.

H. profereoides (Christ) Copel. l.c.—*Aspidium profereoides* Chr. Phil. Journ. Sci. 2 C: 158. 1907.—Near Dallas, in forest near stream (H. 25257, Cl. 27484), Tenompok (Cl. 28942, 28453). Formerly known from Mindanao only.

The specimens agree exactly with the original description, and differ from *H. aspidioides* chiefly in venation. Between the narrow costal areoles and the sinuses are 3 or 4 rows of angular areoles without included veinlets, and outside the larger costular areoles are usually one or two more rows. The dark green leaves are subdimorphous, the fertile ones narrower; the sori are dark brown, oblong to linear; mostly confined to the lobes, arranged in rather regular rows, one each side of the costules. The sterile pinnæ are about 15 cm. long by 3 to 3.5 cm. wide, lobed half-way down, the lobes 7-8 mm. wide, entire, the basiscopic lobes of the basal pinnæ somewhat prolonged. In all other characters the species is very like *H. aspidioides*.

TECTARIA CAVANILLES (*Aspidium* Index).

As usually defined, this is a composite genus, including several natural groups which are not closely related to each other.

T. Leuzeana (Gaud.) Copel. Phil. Journ. Sci. 2 C: 417. 1907.—Kiau (Cl. 10241), near Lobang, in rather open forest on steep slope (H. 25545), Tenompok (Cl. 28749, 29111, 28852, 28287, 29629), Dallas-Tenompok ridge, in Jungle (Cl. 27518).

A very abundant fern near Tenompok, usually on the edge of the forest, sometimes reaching a very large size.

T. Holttumii C. Chr. n. sp.—Habitu, divisione, stipite rachique ebenei *T. melanocauli* (Bl.) Copel. similis, ab ea specie abunda differt: folio toto pilis brevibus, moniliformibus molliter et sat dense pubescente, soris irregulariter conspersis, minimis, indusiis perparvis, peltatis.

KINABALU: near Menetendok, on rocks by river Kadamaian (H. 25570, type in Herb. C. Chr.; Cl. 29516), Dallas (Cl. 27313). Plate 55.

Stipe to 35 cm. long, ebeneous, shortly brown-pubescent, at base with some narrow brown long-acuminate entire scales. Lamina broadly deltoid, 25–30 cm. long and wide, herbaceous, brown when dried, rather densely and softly pubescent throughout with moniliform hairs, consisting of a pair of lateral pinnæ and a terminal pinnatifid portion. Pinnæ to 15 cm. long, short-stalked, acuminate, lobed and coarsely serrate in the outer half, pinnatifid in the inner, the lower side much produced, the basal basiscopic segment 9 cm. long and 2 cm. wide, coarsely serrate, acuminate, the basal acroscopic one triangular acute, 2 cm. long; the apical portion of the frond 20 cm. long and nearly as broad, in division like the basal pinnæ but equilateral, cut in the lower part into a wing 1 to 1.5 cm. on either side of the rachis, the

larger segments in three pairs, the lowest ones 15 cm. long and 3 cm. wide, more deeply serrately lobed on the lower side; costæ ebeneous beneath in the lower third, brown distally; veins densely reticulated between the distinct main veins, the areoles small with free included veinlets. Sori irregularly scattered, very small, sometimes dorsal on the netted veins, or more often apical on extremely short branches; indusia peltate, very small, brown.

Though resembling *T. melanocaulon* in habit, this new species is not nearly related to it, but belongs to a group of closely allied species several of which occur in Borneo, *e.g. T. labrusca, T. platanifolia; T. Holttumii* agrees with these species in pubescence, texture, colour, venation and sori, but it is much more divided than any previously known species of the group.

In Clemens 27313 there are two pairs of lateral pinnæ, the lowest about 22 cm. long. The type is therefore a rather small specimen.

T. coadunata (Wall.) C. Chr. Contr. U. S. Nat. Herb. 26:331. 1931. *Aspidium cicutarium* subsp. *coadunatum* C. Chr. Index.—Near Menetendok, on rocks by river, frond pendulous (H. 25587). New to Borneo.

I cannot distinguish this specimen from the common Himalayan and South Chinese form.

T. malayensis (Christ) Copel. Phil. Journ. Sci. 2C: 416. 1907.—Kiau (Tp. 1541), Kabayau to Koung, on shady banks near stream (H. 25108), near Dahobang river, in forest (H. 25598), Dallas-Tenompok ridge, in ravine (Cl. 26845, 27329).

T. decurrens (Pr.) Copel. l. c. 412.—Menetendok gorge (Cl. 10444), Tenompok trail at 4,000 ft. (Cl. 26859).

T. crenata Cav. (t. sp. orig. herb. Cavanilles).—*Aspidium pachyphyllum* Kunze, C. Chr. Index.—*A. repandum* Willd.—Tenompok, in forest by stream (H. 25404, Cl. 29411, 26931).

Pinnæ lanceolate, 7–8 jugate (or more), the basal ones with a basiscopic lobe, the upper confluent with the pinnatifid or trifid terminal pinna.

T. pleiosora (v. A. v. R.) C. Chr. comb. nov. *Aspidium pleiosorum* v. A. v. R. Handb. Suppl. 199. 1916.—Dallas (Cl. 27295, H. 25726). Also Kudat (H. 25101 and Semanuang river near Sandakan (Kloss 18691).

This species is very near *T. crenata.* The lateral pinnæ are paucijugate, ovate-lanceolate, the lamina on the acroscopic side of the midrib distinctly narrower than that on the basiscopic side (especially in the lower pinnæ), the basal pinnæ simple or rarely lobed (Cl. 27295 has one frond with lobed basal pinnæ), the terminal pinna free or confluent

with the uppermost pair of lateral ones, in the latter case cuneate or almost truncate at the base. The texture is usually more or less coriaceous. The fertile fronds are smaller than the sterile, with shorter and narrower pinnæ. The Kudat specimen quoted has buds on the rachis at the base of the terminal pinna.

The specimens referred here differ in various points, as the above description indicates, but they all agree in having few and broad pinnæ and are thus very different in aspect from typical *T. crenata,* which over a wide geographical range is very uniform in character. Some of the plants around Dallas have unusually broad and coriaceous pinnæ. They were abundant in shady forest slopes near streams, but during my visit were almost all sterile. As in some other species of *Tectaria,* the production of fertile fronds is probably seasonal. (R. E. H.).

T. vasta (Bl.) Copel. Phil. Journ. Sci. 2C: 411. 1907.—s.l. (Low), Koung to Kabayau (Tp. 1910), Kabayau to Koung, abundant on banks near streams (H. 25107). Also Kudat (H. 25103).

Holttum's two specimens are vegetatively quite identical, but while the sori of no. 25107 are apparently exindusiate those of no. 25103 are furnished with small but distinct indusia. In both cases the sori are small and round, not elongate.

T. trifolia (v. A. v. R.) C. Chr. comb. nov. *Aspidium trifolium* v. A. v. R. Bull. Jard. bot. Buitenz. II ser. no. VII: 4. 1912.—*A. terminale* Rosenst. Meded. Rijks Herb. Leiden no. 31: 4. 1917. C. Chr. Gard. Bull. S. S. 4:393, with description.—Kabayau (H., s. n.). Also Kudat (H. 25104).

This species was based on trifoliate specimens from Luzon; in other respects however they are fully identical with Rosenstock's species. Evidently this is a widely distributed fern in the Malayan region. I am inclined to consider it a form of the Sumatran *Aspidium nebulosum* (Bak.) C. Chr.

CAMPIUM Presl, Copeland Phil. Journ. Sci. 37: 341. 1928, *partim.* (*Leptochilus* C. Chr. Index).

C. subsimplex (Fée) Copel. l.c. 356, pl. 8.—Near Dallas, on rocks by stream and in stream bed (H. 25141, 25352), Tenompok, rocky stream in forest (Cl. 27653, 28234).—Sarawak: Segorah river (Brooks, Kew).

New to Borneo, known previously from the Philippines and the Malay Peninsula (Perak, King's Collector 8398, and many recent collections). The Bornean specimens have nearly all simple fronds only, and are without buds. Clemens 28234 has trifoliate fronds. Peninsula specimens

(hitherto usually referred to *Leptochilus Zollingeri*) are nearly always pinnate, except young plants. This species is common on rocks by forest streams in the Peninsula, chiefly at low altitudes.

C. quoyanum (Gaud.) Copel. l.c. 366.—*Leptochilus cuspidatus* C. Chr. Index.—Near Menetendok, on wet rocks by river, the rhizome clinging to the bare rocks (H. 25585).

A form with very few areoles, about as Copeland's fig. 20 d.

LOMARIOPSIS Fee.

L. leptocarpa Fée.—Dallas-Tenompok ridge (Cl. 27596), climbing small trees to a height of 30 feet.

For a discussion of this species, *see* Holttum, Gard. Bull. S. S. 5: 270.

TERATOPHYLLUM Mettenius.

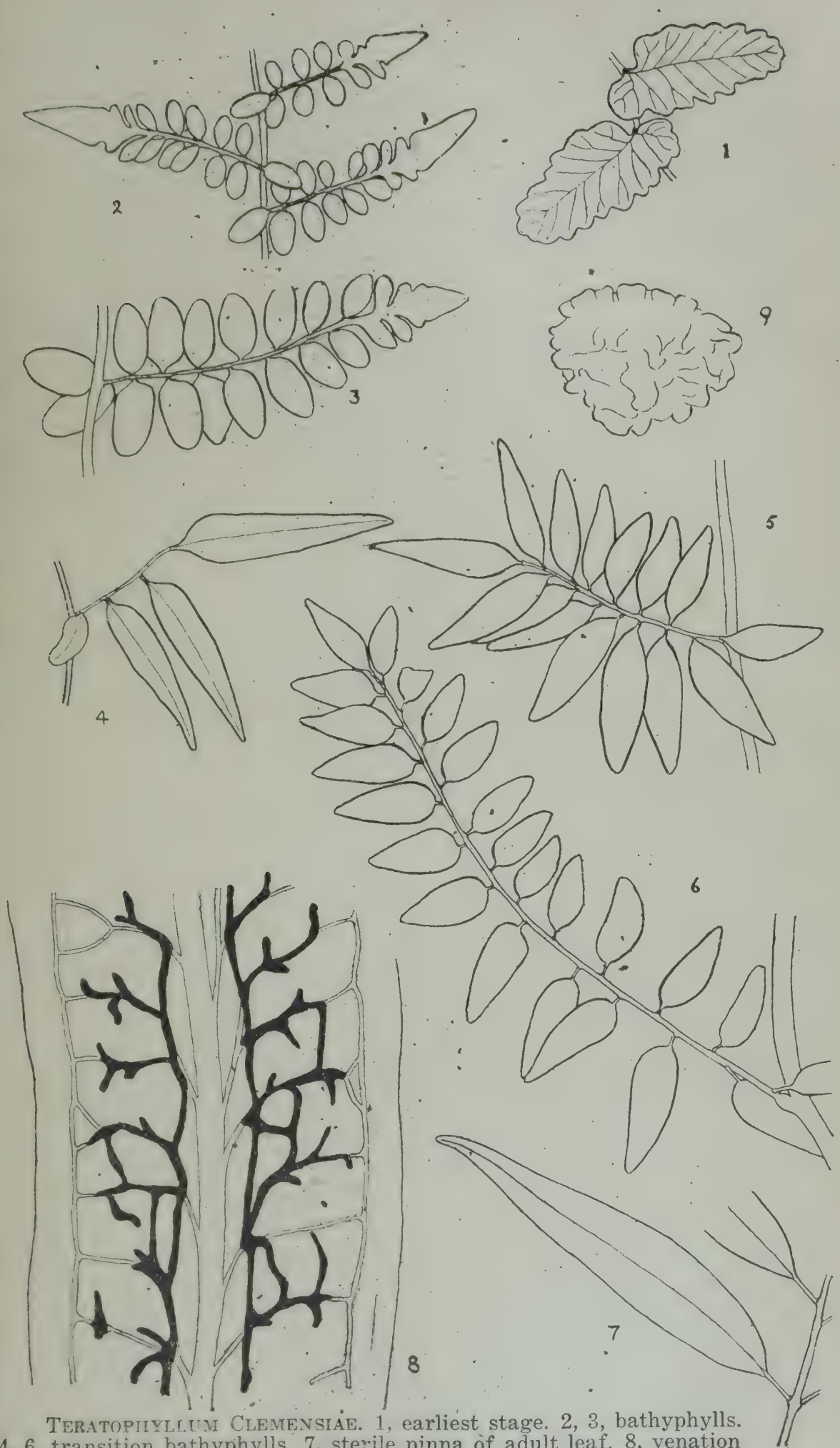
(Holttum in Gard. Bull. S. S. 5:277.1932).

T. Clemensiae Holttum sp. nov. *T. rotundifoliatum* (Bonap.) Holttum affine, differt: bathyphyllis pinnatis, pinnis subintegris; pinnis frondium fertilum c. 5 mm. latis, venis prope marginem unitis, venis soriferis irregulariter transversis.

Youngest stage.—Leaves indistinguishable from those of *T. rotundifoliatum* (Holttum l.c. 285,294), but usually a little larger, to 3 cm. long and 1.5 cm. wide near base, the lower base broadly cordate and overlapping the rhizome, the upper base cuneate, the edges broadly lobed, lobes round, the apex broadly rounded.

Normal bathyphylls.—The smallest of these show transitions from the youngest stage. They are narrowly deltoid, about 4.5 cm. long, base 2 cm. wide, with 3 or 4 pairs of free pinnæ below the deeply lobed triangular apex; the free pinnæ are sessile, elliptic-obovate, edges entire or slightly sinuate, base unequally cuneate, apex rounded; the lowest pinna on the lower side is reflexed and overlaps the rhizome. The largest normal bathyphylls seen are about 9 cm. long by 4 cm. broad, the pinnæ about 9 pairs below the lobed triangular apex, largest pinna about 2.2 cm. long by 1.0 cm. wide, base very broadly cuneate, widest near base and narrowed slightly to the broadly rounded apex, edges sinuate; the lowest pinna always reflexed and overlapping the rhizome at right angles.

Transition bathyphylls (pinnæ all articulate). These are of several different types on different specimens, and appear to vary according to conditions of environment. The character they have in common is that all pinnæ are



TERATOPHYLLUM CLEMENSIAE. 1, earliest stage. 2, 3, bathyphylls. 4–6, transition bathyphylls. 7, sterile pinna of adult leaf. 8, venation of fertile pinna; soral veins black. 9, spore. All half natural size except: 1, × ¾; 8, × 8; 9, × 175.

entire (or nearly so) and of shape similar to those of the adult fronds; as in almost all bathyphylls, the lowest pinna is reflexed to overlap the rhizome at right angles. Three different types may be briefly described, but there are intermediate forms also.

(1) Dimidiate type. Fronds consist of a terminal pinna with 1 to 3 lateral pinnæ on the lower side only, upper side of rachis without pinnæ; lateral pinnæ sometimes absent, the reflexed basal one often so. Terminal pinna 5-9 cm. long, 1.2 to 2 cm. wide; lateral pinnæ somewhat smaller. Texture thin, probably indicating a moist habitat. These fronds have been found on the same piece of rhizome with small normal bathyphylls.

(2) Fully pinnate, small. Fronds 7–12 cm. long, 4.5–8 cm. wide, pinnæ 6–8 pairs, close (usually touching each other), short-stalked, largest pinnæ about 5 cm. long by 1.2 cm. wide, broadest near the broadly cuneate base, gradually tapered to the narrowly rounded apex, edges entire or slightly sinuate, texture subcoriaceous. Pinnæ on the lower side of the rachis usually somewhat larger than those on the upper side.

(3) Fully pinnate, large. Fronds to 18 cm. long by 6 cm. wide, pinnæ, about 10 pairs, on stalks 3 mm. long, those on lower side of rachis about 1.5 times larger than those on upper side, largest pinnæ about 3.5 cm. long by 1.3 cm. wide, broadest near the broadly cuneate base, narrowed evenly to the slightly rounded apex, texture subcoriaceous.

Adult plant. Rhizome.—Diameter to about 5 mm. colour green, somewhat muricate, surface of younger parts more or less densely covered with scales (*see* below), leaf-bases (to which the leaves are articulate) swollen and prominent.

Sterile fronds.—Usually about 40 cm. long (including stipe) and 17 cm. wide; largest seen 70 cm. long by 25 cm. wide. Stipe of smaller fronds 5 cm. long, of largest frond 15 cm. Rachis very narrowly winged in distal part only. Pinnæ about 10 pairs, alternate, all articulate, on stalks 5–10 mm. long, largest seen 15 by 2.3 cm., more usually about 8 by 1.5 cm., broadest near base, tapering gradually to an acuminate apex, base broadly unequally cuneate; texture thin but firm, colour usually rather light green; midrib prominent above and below, usually pale; veins about 2 mm. apart, slightly prominent on both surfaces, simple or forked, ending just within the margin; margin slightly reflexed, narrowly cartilaginous, and regularly sinuolate, the prominent parts opposite the vein endings.

Fertile fronds.—Two seen, 40 cm. long, 10 cm. wide, stipe about 10 cm, pinnæ 10–12 on each side, petiolules 10 mm., lamina 5–7 cm. long, about 5 mm. wide; lower surface, except for the pale thin edge, covered with sporangia; veins uniting in a submarginal vein, with soral veins, close to the lower surface, irregularly crossing the areolæ so formed.

Scales scattered over surfaces throughout all parts of the plant, largest on rhizome and smallest on leaf-surfaces, castaneous, lanceolate, base peltate, edges bearing glandular hairs, largest about 1 mm. long, all more or less deciduous.

KINABALU: Penibukan, on Polyalthia tree, Clemens 31614, type in Herb. Singapore; also Cl. 31346 (sterile). Tenompok, Clemens 29566.

This species is closely allied to *T. rotundifoliatum,* both the youngest stage and the adult sterile fronds of the two species being hardly distinguishable; the only character in which the adult sterile fronds differ at all clearly is in the margins of the pinnæ which in *T. Clemensiae* are finely sinuate. The bathyphylls of the two species however differ so markedly as to distinguish them very sharply; *T. rotundifoliatum* has beautiful bipinnate fronds with almost circular pinnules, *T. Clemensiae* simply pinnate fronds with almost entire pinnæ. The transition bathyphylls also differ, those of *T. rotundifoliatum* having very narrow deeply lobed pinnæ, those of *T. Clemensiae* broad entire pinnæ like those of the adult fronds. The distinction of the fertile pinnæ seems also to be a good one. The fertile pinnæ of *T. Clemensiae* are only half as wide as those of *T. rotundifoliatum;* and the veins unite in a submarginal vein which is absent in *T. rotundifoliatum;* the soral veins of *T. Clemensiae* are also much less regular than those of the other species.

This species gives further evidence that in Teratophyllum the bathyphylls or early stages of development may be as important diagnostically as the adult form of the plant, or even more important; the necessity for full and careful collection of all stages is evident, and we are fortunate to have such a fine series of specimens of the present species, which I have pleasure in dedicating to Mrs. Clemens.

LOMAGRAMMA J. SMITH.

L. Brooksii Copel. Phil. Journ. Sci. 3C: 345 1908.—Near Dallas (H. 25251), Tenompok (Cl. 28638).

No fertile specimens were collected. Young plants, creeping on wet rocks by streams, have slender rhizomes and more or less erect fronds (depending on the inclination of the rock surface) on rather long stipes. The stipes of

some specimens collected by Clemens are 35 cm. long. The pinnæ of these fronds are at most about 7 cm. long by 2 cm. wide, the edges parallel for most of their length, the upper base very broadly truncate, the lower narrowly truncate or rounded, the apex falcate and shortly attenuate, the edges quite entire or slightly toothed towards the apex; the lower pinnæ are gradually reduced.

Older plants, or at least plants which have begun to climb a tree, have a thick rhizome closely similar in appearance and structure to the rhizome of *Lomariopsis spp.;* their fronds are of full size, and grow out horizontally from the tree. These fronds have short stipes as described by Copeland, and the basal pinnæ are gradually smaller. The upper pinnæ are oblanceolate, broadest one-third from the apex, the base suddenly truncate or broadly cuneate (less unequally than in young fronds), the apex less falcate than in young fronds.

Judging from my field experience in the Peninsula and in Borneo, I believe that the species of Lomagramma are often more easy to distinguish from their young creeping stage than from fronds of mature climbing plants; in this they agree with Teratophyllum. I am sure at least that we shall not have a proper knowledge of the species of Lomagramma until all stages have been collected for all species. As the plants rarely produce fertile fronds, they are apt to be neglected by collectors, no doubt from the idea that sterile material is useless; actually in this genus full sterile material of all stages is quite adequate to characterise the species, and the fertile fronds are usually the least distinctive features specifically. (R. E. H.).

ATHYRIUM Roth.

This genus is here taken in the sense of my Index Filicum (*see* the remarks under *Diplazium* on p. 268). Most species found on Kinabalu belong to a specialised group characterised by often much-divided leaves of a dark green (when dried nearly black) colour, and dark axes.

A. macrocarpum (Bl.) Bedd.—Pakka (Cl. 10586, H. 25526), above Marei Parei (H., s. n.), Silau basin, among rocks, 3,000 to 7,000 ft. (Cl. 29033), Lumu trail (Cl. 27947).

A form of this polymorphous species with narrow, bipinnatifid leaves and strongly auricled pinnæ, much resembling the form described as *A. anisopteron* Christ.

A. Clemensiae Copel. 1917: 58.—Low's Peak (Cl. 10621, 29034, 27007, Boden Kloss s. n. 1928), in rock crevices at 12,000 ft. (H. 25486), Pakka to summit (Tp. 1698, 1705, Cl. 27049, 27944, 27782). Also a collection of Clemens labelled Tenompok ? (no. 28965).

A. Moultoni Copel. Journ. Str. Br. R. Asiatic Soc. no. 63: 71. 1912.—Pakka cave to Lobang (Tp. 1756, Cl. 10725 ?), below Pakka, occasional, in more shady parts of ridge forest (H. 25518, Cl. 27967, 28975).

Topping 1756 was referred to this species by Copeland, and perhaps rightly, though it does not quite agree with the type from Bukit Lawi. The other specimens quoted are exactly identical, and belong here, I think. They are large: the stipe up to 1 metre long, lamina tripinnate-quadripinnatifid, deltoid, the lower pinnæ 30 cm. long, 10 cm. wide. The colour, scales and sori are as in the type. I find however a peculiar difference, and am therefore not quite sure that these specimens are *A. Moultoni*. In many species of *Athyrium* the raised edges of the sulcate costæ or costules are prolonged (on the upper side) into fleshy spines at the base of each pinnule or segment. In the specimens above quoted these raised edges are high, wing-like, and at the base of the pinnules considerably widened, suddenly abrupted, and run with a bluntly rounded outer edge from the costule along the base of the midrib of the tertiary pinnule, resembling an auricle which is closely appressed to the upper side of the quaternary segment.

A. atropurpureum Copel. 1917: 59.—Low's Peak (Cl. 10620, Tp. 1696).

A. pulcherrimum Copel. Phil. Journ. Sci. 8C: 141, pl. 3. 1913.—Pakka cave (Tp. 1716, H. 25507, Cl. 30446).

More dissected than the Javanese type, tripinnate-quadripinnatifid. In size, texture, colour and cutting, a perfect mimicry of *Leucostegia hymenophylloides*.

A. amoenum C. Chr. n. sp. affinis *A. pulcherrimo*, textura tenuior, magis divisa. Rhizomate? Stipite 35 cm. longa, superne bisulcato, brunneo, præsertim versus basin paleis rufo-brunneis, late lanceolatis acuminatisque, mollibus, sat dense obtecto. Lamina deltoidea vel latissime ovata, ad 50 cm. longa, 30–35 cm. lata, obscure viridi, textura tenuissima, quadripinnata-pinnatifida, rachi nuda et ut tota planta glaberrima. Pinnis 9–10–jugis, inferioribus oppositis, 9 cm. inter se remotis, sessilibus vel brevissime petiolulatis, late ovato-lanceolatis, ad 20 cm. longis, 10 cm. latis, breve acuminatis, versus basin paulo angustatis, superioribus alternis, costis paleis parvis luteo-brunneis sparse onustis. Pinnulis II alternis, breve petiolatis, maximis 5–6 cm. longis, 1.5 cm. latis, basi latere acroscopico aliquot producto inæquilateralibus, acutis, basalibus pinnarum infimarum I ord. abbreviatis; pinnulis III 1 cm. longis,

petiolatis, basi postice cuneatis antice truncatis, productis, parte dimidia inferiori pinnatis, sursum profunde pinnatifidis; pinnulis vel segmentis IV lobatis vel dentatis, dentibus acutis. Venis distinctis, sæpe nigricantibus; soris costularibus, vix 1 mm. longis, indusiis semi-ovatis, rufo-brunneis, integris vel leviter laceratis.

Kinabalu: Kamborangah, near river in forest (H. 25530, type in Herb. C. Chr.), Silau basin (Cl. 29045), Falls above Lumu (Cl. 29967 part).—Sarawak: Mt. Murud (Mjoberg). Plate 56.

This is the most finely dissected of all Asiatic *Athyria*, and a very pretty species. I described it some years ago from Dr. Mjoberg's specimen, but now take Mr. Holttum's more complete one as the type. *A. amoenum* has several characters in common with *A. pulcherrimum, e. g.* colour, scales, and sori, but it is much finer cut and of much thinner texture. Costular spines are present, but mostly very short or quite obsolete.

A. silvaticum (Bl.) Milde.—Lobang, a solitary plant on rocks by stream (H. 25562 Cl. 29591). New to Borneo.

A form with short sori and vaulted indusia.

DIPLAZIUM Swartz.

In 1908 Copeland, following Milde, transferred to *Athyrium* the Philippine species formerly placed in *Diplazium* (Phil. Journ. Sci. 3c: 285), and in his later papers he has described a considerable number of diplazioid ferns as species of *Athyrium*, thus dropping the whole genus *Diplazium* (*see* also his paper: The Oriental Genera of Polypodiaceæ, Univ. Cal. Publ. Bot. 16, no. 2. 1929). I agree with him in the opinion that there does not exist a really generic difference between most species hitherto referred to the two genera, but I fear that it is too unnatural to merge the whole mass of species of *Diplazium* in *Athyrium*, because both genera comprise species of very remote relationship. The type-species of *Athyrium* forms, together with a number of related (mostly northern) species, a well-defined group or genus to which *Cystopteris* (*C. fragilis, bulbifera* and relatives) should probably be referred. Other species of *Athyrium* (*A. crenatum* and relatives) should be united with *Cystopteris montana* into another group. Most of the other species of *Athyrium* could very naturally be united with most species of *Diplazium* into one genus, for which the latter name should be used. From this genus certain species, which I cannot see how to distinguish from

Asplenium, should be excluded; among these are *D. porphyrorachis* and *D. pallidum*. Being therefore of the opinion that both genera, as arranged in the Index Filicum, are polyphyletic, I prefer to retain that arrangement pending the further study which is necessary to define the various constituent groups.

D. grammitoides Presl—*Asplenium biseriale* Bak. 1894:252, *Diplazium* C. Chr. Index, *Athyrium* Copel. Keys 376.—s.l: (Haviland 1475, Cl. 11011), near Menetendok, on mossy rocks by edge of river (H. 25577), Silau basin, stream bed between rocks (Cl. 29052).

I cannot distinguish Baker's species from the Philippine type, even as a variety.

D. crenato-serratum Bl. forma—Marei Parei ridge (Cl. 10914), Dallas-Tenompok ridge (Cl. 28155).

D. Hosei Christ is a rather typical form of this species, and *D. larutense* Bedd: (syn. *D. confertum* (Bak.) C. Chr.) is a form with close obtuse pinnæ.

D. sp. near *japonicum* (Thbg.) Bedd.—Near Menetendok, in forest near river (H. 25579).

Perhaps this was also collected by Mrs. Clemens and Topping, as specimens of theirs are said by Copeland (Keys 376, under *Athyrium biseriale*) to be intermediate between *D. japonicum* and *D. Petersenii;* this is true also of Holttum's specimen, but it cannot be referred to either of the two species. The sori seem to be exindusiate. I prefer to let it remain unnamed. It comes very near *D. Woodii* Copel.

D. pallidum (Bl.) Moore—Lobang, on rocks by stream (H. 25559).

I should prefer to retain this species in *Asplenium*.

D. poiense C. Chr. n. sp.—Rhizomate spec. typ.? (in spec. Kinabaluensi erecto, crasso, apice paleis castaneis, nitidis, anguste lanceolatis, in pilum longum desinentibus, integris dense obtecto). Stipite 30 cm. vel ultra longo, ut rachi atro-brunneo, opaco, supra basin sparse paleaceo. Lamina late lanceolata, ad 60 cm. longa, 25 cm. supra basin lata, firmiter herbacea vel papyracea, superne gramineo-viridi, glabra, inferne pallida, ad costas squamulis brunneis sparse prædita, bipinnatifida, versus apicem pinnatifidum sensim attenuata, versus basin vix angustata. Pinnis ad 20-jugis, alternis, 3 cm. inter se remotis, breve petiolulatis, subhorizontalibus, longe acuminatis, ad 15 cm. longis, 2–2.5 cm. latis, basi et medio eximie inæquilateralibus (latere acroscopico medio 1.5 cm. lato, basiscopico medio 1 cm. lato et versus basin valde reducto), e medio versus apicem æquilateralibus, ad alam 5 mm. latam pinnatifidis.

Segmentis oblongis, plerisque falcatis, obtusis, 4 mm. latis, obtuse serratis, sinubus angustis separatis, basalibus basiscopicis valde reductis. Venis simplicibus, remotis, valde obliquis, non prominentibus, in segmentis majoribus 5-6-jugis. Soris in lobis ca. 1 mm. a nervo mediano remotis et marginem fere attingentibus, parte costali pinnarum fere 1 cm. lata indivisa sterili. Indusiis brunneis, integris, nonnullis diplazioideis, margine exteriore revoluto striam elevatam ad superficiem relinquente.

SARAWAK: foot of Mt. Poi (Mjöberg, type in Herb. C. Chr.). Kinabalu: Tenompok (H. 25380, Cl. 28412, 29275).

A most distinct species, easily recognised by the unequal-sided pinnæ, the upper side of which is much broader in the lower half than the basiscopic one, and by the sori being placed far from the costa and midrib of the lobes, confined to the marginal half of the lobes. The recurved indusia leave at their outer edge an elevated rim similar to that found in *Asplenium scolopendrioides*. This rim is not so evident in Holttum's specimen, which is otherwise very like the type except for the stipe and rachis being lighter in colour. The rim is distinct in the Clemens specimens, which are also larger, with pinnæ to 20 cm. long and 3.5 cm. wide.

Related to *D. poiense* is **D. falcinellum** C. Chr. nom. nov. (*Asplenium matangense* Hose, Jour. Str. Br. R. Asiatic Soc. no. 32: 58. 1899), a species that has been overlooked by almost all writers. It was re-collected by Dr. Matthew on Mt. Matang, Sarawak, in 1912. Dr. Matthew believed it to be my *D. matangense* Index Suppl. 27 (1913), which however is another name for *Athyrium carnosum* Copel., a quite different species. Matthew's fine specimens at Kew show a close resemblance to *D. poiense* in colour and in the shape of the pinnules, but the fronds are bipinnate-pinnatifid; the lower pinnæ resemble strikingly a whole smaller frond of *D. poiense*, the upper ones (and all pinnæ of smaller fronds) have subentire, auricled, falcate pinnules. Further, the species differs from *D. poiense* in its thinner fronds without scales above the base of the stipes, and in the scales of the rhizome, which are light red-brown and broader.

D. Christii C. Chr.—Gurulau spur (Cl. 10860).

Named by Copeland, probably correctly. Scales very few, lanceolate, brown, entire.

D. tricholepis C. Chr. n. sp. *D. Christii* magnitudine, divisione, figura laciniarum, textura sorisque valde similis, ab ea differt: stipite, rachi et costis infra paleis

filiformibus, brunneis, ciliato-dentatis (dentibus pallidis) sat dense vestitis, pinnis infimis multo abbreviatis. KINABALU: Kamborangah, near small streams in forest (H. 25522, type in Herb. C. Chr.), falls above Lumu, in gorge (Cl. 29579). Plate 57.

Stipe 25 cm. long with many lanceolate brown minutely ciliate scales at base. Lamina broadly lanceolate, 70 cm. long, 25 cm. wide, bipinnatifid. Pinnæ sessile, truncate at base, acuminate, incised to a wing 2 mm. broad, the segments patent, triangular-oblong, 6–7 mm. wide at base, those of the lower side usually somewhat longer than the upper ones (1.4 against 1.2 cm.), obtuse and toothed in the outer half or occasionally acute on the lower pinnæ. Veins dark, 6-7-jugate, forked or simple; sori narrow, straight, extending from the costa nearly to the edge, the acroscopic basal one diplazioid.

The description here given fits *D. Christii* equally well, except that the scales are very different.

D. speciosum Bl.—Tenompok to Lumu Lumu, terrestrial in forest (H. 25444).

A widely-spread species which I united with *D. sorsogonense* Pr. in my Index, probably wrongly. The specimen quoted agrees excellently with another in my herbarium from Java which I have noted as typical. It is larger than the two former species, subcoriaceous, much deeper incised, sub-bipinnate, the pinnules or segments spaced, oblong, subacute, 15–18 mm. long by 5 mm. wide, serrate nearly from the base. The scales are very few, linear.

D. lævipes C. Chr. n. sp.—Rhizomate breve repente, radicibus crassis nigris multis vestito; stipitibus fasciculatis. Stipite ad 55 cm. longo brunneo, lævi glabroque, basi sparse paleaceo sursum subnudo (paleis brunneis, integris, basi peltatis, mox deciduis hinc inde præditis). Lamina ovata, ca. 70 cm. longa, supra basin 35 cm. lata, tenuiter papyracea, infra (sicca) brunnea, glaberrima nudaque, basi bipinnata sursum bipinnatifida, rachi 10 cm. infra apicem superne gemmifera. Pinnis subalternis; inferioribus 8 cm. inter se remotis, petiolatis (petiolo 2 cm. longo); iis secundi paris maximis, ad 25 cm. longis, medio 8 cm. latis (infimis paulo brevioribus), breve acuminatis, versus basin angustatis et pinnatis (pinnulis liberis 1-3-jugis, adnatis), sursum profunde pinnatifidis, segmentis medialibus maximis, ca. 4–5 cm. longis, 1–1.2 cm. latis, acutis, serratis; pinnis superioribus sessilibus, pinnatifidis, segmentis ca. 2 cm. longis, 7 mm. latis, subcontiguis, oblongis, obliquis, versus apicem postice rotundatum antice subacutum dentatis, basalibus acroscopicis multo reductis.

Venis in segmentis majoribus pinnatis, in minoribus e medio furcatis (ramis confertis) vel simplicibus. Soris angustis e costula vix ultra medium segmenti extensis, multis diplazioideis; indusiis perangustis, cito evanidis.

KINABALU: near Dallas, terrestrial in forest (H. 25259, type in Herb. C. Chr.), Kiau (Tp. 1537). Plate 58.

Closely related to *D. spiniferum* v. A. v. R. Handb. Suppl. 265 (*Athyrium muricatum* Copel.) from Sarawak and Dutch Borneo (Hallier 3227), to which Copeland referred Topping 1537. That species is quite similar in size, colour and division, but the stipe is prickly, the segments all entire, the sori far from the costule, and the frond coriaceous. *Athyrium carnosum* Copel. is another near ally with thick, nearly carnose fronds.

D. barbatum C. Chr. n. sp.—Rhizomate breve erecto, stipitibus fasciculatis. Stipite ad 30 cm. longo, brunneo, sulcato, ubique cum rachi densissime squamoso; squamis plus minusve squarrosis, lanceolatis vel linearibus, inferioribus maximis, in apicem piliformem minute dentatum longissime acuminatis, brunneis, concoloribus. Lamina late lanceolata, ad 65 cm. longa, 30 cm. lata, obscure viridi, papyracea, bipinnata vel folii minoris bipinnatifida, rachi ut stipite squamis (parvioribus) barbata. Pinnis folii majoris alternis, sessilibus, 8 cm. inter se remotis, maximis 15 cm. longis, 5 cm. latis, infimis paulo abbreviatis, basi æqualiter truncatis, breve acuminatis, fere omnibus infra apicem pinnatifidum pinnatis; pinnulis liberis ca. 10-jugis, alternis, patentibus, ad 2.5 cm. longis, 1 cm. latis, basi late ad costam adnatis, apice acutis vel rotundatis, plus minusve profunde crenulato-serrulatis, apicem versus sæpe leviter dilatatis; costis costulisque inferne ut rachi dense barbatis, superne sparse fibrillosis. Venis prope basin furcatis, ramo basiscopico sæpissime iterum furcato vel subpinnato, acroscopico solum sorifero. Soris angustis, e costula fere ad marginem extensis, obliquis et sæpe curvatis, infimis diplazioideis; indusiis brunneis, integris.

Adest etiam planta minor, foliis bipinnatifidis, pinnis 9 × 2.5 cm., profunde pinnatifidis, segmentis 5–6 mm. latis, sub apicem rotundato-obtusum leviter dentatum integris.

KINABALU: Tenompok, terrestrial in forest (H. 25386, type in Herb. C. Chr.; Cl. 29413). Plate 59.

Somewhat resembling *D. speciosum* in general habit, colour and texture, but very distinct by its densely squamose stipe, rachis and costæ. The smaller bipinnatifid fronds may easily be confused with *D. tricholepis* (described

above), but the shape of the segments is different; in *D. barbatum* they are of equal width from base to tip, or not rarely broadest above the middle, never triangular-oblong.

D. Hewittii (Copel.) C. Chr. Index Suppl. 26. 1913. *Athyrium* Copel. Phil. Journ. Sci. 7C: 62. 1912.—Marei Parei ridge, terrestrial in low ridge forest (H. 25616).

A small leaf, which I think may be referred here, as it agrees well with the type from Mt. Matang in its rigid texture, in the degree of division, and in the costular short sori; but the pinnules are at best 2 cm. long and 5–6 mm. wide. (A larger frond, in the Singapore herbarium, has pinnules to 5.5 by 1.5 cm.). A beautiful series of specimens collected by Mjöberg in Sarawak has shown that *A. Hewittii, A. sarawakense,* and *A. paripinnatum* of Copeland are probably all forms of the same species, different in size, but otherwise scarcely distinguishable.

D. vestitum Pr. var. **borneense** n. var.—A typo Philippinensi differt: fronde crasse coriacea, rachi costisque subnudis, paleis perpaucis, parvis, marginibus nigris, dentatis.

Path to Dallas, wet ground by stream (H. 25134), Tenompok (Cl. 28690, 27734, 27478), Koung to Kabayau (Cl. 27676). Also: Bettotan near Sandakan (Boden Kloss 19049), Rian (Burbidge).

These specimens are quite identical, and I am rather in doubt whether they should be referred either to *D. vestitum* or to *D. crinitum* (Bak.) C. Chr. They agree best with the former in general appearance, (cf. Hook. Sec. Cent. pl. 46), though the pinnules are short-acuminate. The strong stipe is rather scaly, but the scales soon fall, leaving the bases as short soft spines. The scales, like those of *D. crinitum,* are bordered with an ebeneous, sharply toothed edge. I have not observed such scales in the old specimens of *D. vestitum,* but they should be sought for in fresh specimens. The scales of the axes of *D. crinitum* are stalked and very peculiar (cf. Copeland, Brittonia 1: 73. 1931).

D. dilatatum Bl.—*D. maximum* C. Chr. Index p.p., *Athyrium* Copel. Keys 378.—Lobang (Tp. 1784, H. 25555), Tenompok (Cl. 29419).

The nomenclature of the large bipinnate species of *Diplazium* is very confused, and it seems to me better to use Blume's certain name rather than Don's two doubtful ones, *maximum* and *latifolium,* which must be applied to Himalayan forms. No. 25555 agrees excellently with a cotype specimen of *D. dilatatum* at Kew. The stipe is not spiny. The status and nomenclature of the many species or forms allied to *D. polypodioides* cannot be defined until the whole group is revised.

D. polypodioides Bl.—Gurulau spur (Gibbs 4,000). Not seen.

D. asperum Bl.—Koung to Kabayau, on bank by bridle path, locally abundant (H. 25630), Tenompok (Cl. 28080).

D. atrosquamosum (Copel.) C. Chr. comb. nov. *Athyrium atrosquamosum* Copel. Phil. Journ. Sci. 12C: 59. 1917.—Marei Parei ridge (Cl. 11051), Tenompok to Lumu Lumu, terrestrial in forest, frequent (H. 25429), Tenompok (Cl. 27122, 28410, 28286, 28103), Lumu trail (Cl. 28391), above Kamborangah (Cl. 27951), falls above Lumu (Cl. 29716, young plant).

Very near *D. polypodioides* Bl. (*Athyrium Blumei* Copel.), but firmer in texture, the stipe slightly asperous below, not spiny, and the sori costular, very short. Holttum's specimens are no doubt this species, although the basal scales on stipes are brown, not black as in the type. The scales on an unexpanded frond are black.

D. tabacinum Copel. Phil. Journ. Sci. 1 Suppl. 149, pl. 6. 1906. *Athyrium* Copel. l.c. 3C: 292. 1908.—Near Lobang, in forest near river (H. 25565), Dallas-Tenompok ridge (Cl. 26818).

Very like *D. cordifolium* var. *pariens*, but dark coloured, all pinnæ rounded-cuneate at base and sessile, no buds on the rachis, and the veins mostly free, though frequently united just within the margin.

D. cordifolium Bl.—Near Dallas, frequent in forest (H. 25140, Cl. 27385, 26898), above Lumu (Cl. 27062).

var. **pariens** (Copel.). *Athyrium pariens* Copel. Phil. Journ. Sci. 3C: 299. 1908. Keys 380.—Gurulau spur (Tp. 1631), near Dallas, on ground in forest (H. 25139, Cl. 27433), Tenompok (Cl. 29422, 26950, 27502), above Lumu, on rocks (Cl. 27066).

Several intermediate specimens have convinced me that this is a form of *D. cordifolium* with 7–8 pairs of pinnæ and with buds in the axils of the upper ones.

There is also a small plant with a few close lateral pinnæ (Dallas-Tenompok ridge, Cl. 28338).

D. bantamense Bl. var. **alternifolium** (Bl.) v. A. v. R. Handb. 406.—Tenompok (Cl. 27195, 29406).

These specimens match very well some from the New Hebrides (Herus 82) named thus by Kuhn, but I am not sure of the identification. They differ from *D. bantamense* in the greater number of pinnæ, which are up to 30 cm. long by 5 cm. wide, subcuneate or rounded or even truncate at the base, coarsely serrate towards the long-acuminate apex. Scaly buds are borne in the axils of the upper pinnæ.

D. fraxinifolium Presl var. **grossum** (Pr.). *Anisogonium*

grossum Pr., Epim. Bot. 93. 1851.—Near Dallas, terrestrial in forest (H. 25258), Tenompok (Cl. 29438, 26855, 27733).

Holttum's specimen matches exactly the Kew specimen of Cuming's no. 305, from Leyte, the type-number of Presl's species, which has never been described. Pinnæ 6 pairs below a terminal one, up to 33 cm. long by 6 cm. wide, entire or undulate-repand, serrate toward the suddenly acuminate apex, pale green, thin, the basal ones very shortly stipitate, the upper adnate to the rachis. Veins sparsely anastomosing near the margin, not rarely free. *D. xiphophyllum* (Bak.) C. Chr. from Labuan (Burbidge), to which I refer *D. palauanense* Copel., is, I think, just the same, with all veins free. It has been collected also in Pahang at Ulu Chineras (Burkill, Herb. Singapore 15692).

DIPLAZIOPSIS C. Chr.

D. javanica (Bl.) C. Chr.—Near Menetendok, on rocky stream bank, in shade (H. 25581), Silau basin, on rock by stream at 7,000 ft. (Cl. 29036) New to Borneo.

ASPLENIUM Linn.

A. nidus L.—Tenompok (Cl. 28725, 28577).
var. **ellipticum** (Fée) ?—Lobang (Cl. 10324).
var. **phyllitidis** (Don)—Dallas, East ravine (Cl. 27304).

A. batuense v. A. v. R. Bull. Dép. Agr. Ind. Néerl. XVIII: 13. 1908; Handb. 443; Bull. Jard. bot. Buit. III ser. 2: 132. 1920.—*A. Brooksii* Copel. Phil. Journ. Sci. 6C: 137. 1911.—*A. Grashoffii* Rosenst. Fedde Repert 13: 215. 1914. Distribution: Sarawak, Batu Islands, Sumatra, Malay Peninsula.

forma **angusta** ?—Leaves 3–3.5 cm. wide only. *A. concolor* Copel. Keys 383.—Kiau to Lobang (Tp. 1593).

I have seen the types of the three species quoted above, and find no essential difference between them. I am more in doubt about the right name for the Kinabalu fern, but I believe it is referable to the present species. It is certainly not *A. concolor* Hk., as believed by Copeland; *A. concolor* is furnished with small lacerate scales beneath.

A. scolopendrioides J. Sm.—*A. glochidiatum* Racib. (t. sp. orig.)—Tenompok, on bases of trees in forest (H. 25383, Cl. 26830, 27193, 28457, 27477), Dallas, East ravine (Cl. 27373).

Known previously from the Philippines (Cuming 318, type!) and Borneo, recently collected in the Anamba Islands (Henderson, Herb. Singapore 20198) and Pulau Tioman,

Pahang (Henderson 18763); it has once been collected on the mainland of the Malay Peninsula, near Raub, Pahang (Best 14166).

Young plants of this species first bear leaves deeply lobed to a narrow wing, the lobes narrow and distant; on a leaf 5 cm. long there are 4 lobes on each side, the lobes about 2 mm. wide. Older plants have the wing progressively wider and the lobes shorter and closer.

A. squamulatum Bl.—Koung, on rocks in shade (H. 25122), Dallas (Cl. 27309, 27231).

A. natunae Baker, from the Natuna Islands (Hose 321) is to me a rather typical form of this species.

A. trifoliatum Copel. Phil. Journ. Sci. 5C: 284. 1910.—*A. prolificans* v.A.v.R. Bull. Jard. Bot. Buitenz. II ser. XI: 4. 1913.—Kiau to Lobang (Tp. 1604), Tenompok (Cl. 29429), Dallas (Cl. 26818 bis).

Pinnæ more numerous (5 pairs) and smaller than in Sarawak specimens, but certainly the same species. A beautiful series from Mt. Merinjak, Sarawak (Nat. Coll.) show simple fronds with lamina 70 by 11 cm., and pinnate ones with 1-2-3-4 pairs of pinnæ below the large terminal proliferous one.

A. filiceps Copel. Phil. Journ. Sci. 5C: 285. 1910.—*A. cuspidifolium* v. A. v. R. Bull. Jard. bot. Buitenz. II ser. XX: 7. 1915.—Below Dallas, on rock by stream, pendulous (H. 25360), below Kabayau (Cl. 27688 simple and pinnate).

Evidently this is a common species in Borneo, where it has often been collected. It occurs also in the Malay Peninsula, having been found in Pahang, S. Sat (Henderson, Herb. Singapore 22080).

Copeland described *A. filiceps* after specimens from Tringos, Sarawak (Brooks 21!) with simple fronds, but it is certain that this species, like many others of this group, may bear both simple and pinnate fronds, often on the same rhizome; this condition is found in a beautiful series of specimens from Mt. Merinjak, Sarawak (Native Coll. Sarawak Mus. 139, 156). In the Pahang specimen quoted above, the number of pinnæ varies from one to several pairs. In Holttum's Kinabalu specimen there are 8 pairs of lateral pinnæ, and this number also is quoted for *A. cuspidifolium*. The species is certainly closely related to *A. vulcanicum* Bl., and the two are often united. *A. filiceps* however seems to me sufficiently different in its usually thinner texture, the pinnæ very long-cuspidate at the apex and rounded-cuneate or even truncate at the base, not long-cuneate. It is more difficult to see how the smallest forms may be distinguished from *A. salignum* Bl.

A. pachychlamys C. Chr. n. sp.—Rhizomato breve repente, paleis clathratis, atro-brunneis, lanceolatis, ad 1.5 cm. longis, integris, dense vestito. Stipite 30 cm. vel ultra longo, brunneo, opaco, ut tota planta glaberrimo, juvenili sat dense paleaceo, paleis parvis angustis basin versus ciliatis cito delapsis. Lamina pinnata cum impari, coriacea, subtus pallida, ad 50 cm. longa; rachi colore stipitis, superne applanata vel latissime sulcata; pinnis ca. 9-jugis, suboppositis, 5 cm. inter se remotis, adscendentibus, breve petiolulatis, linearibus, usque ad 25 cm. longis et 1 cm. latis, versus basin longe et inequaliter cuneatis, versus apicem longe et gradatim attenuatis, marginibus levissime et remote dentatis, pinna terminali simili. Venis indistinctis, valde obliquis, simplicibus, fere omnibus soriferis; soris e costa fere ad marginem extensis; indusiis pallidis, crassis, integerrimis, 1 mm. vel ultra latis, ad superficiem pinnæ appressis, sæpe contiguis.

KINABALU: Tenompok, epiphytic on tall tree (H. 25355, type in Herb. C. Chr.); also Tenompok (Cl. 29228, 28027, 26983), Pakka (Cl. 27963).

This is a most distinct and peculiar species, quite different from all others by its long narrow coriaceous and glabrous pinnæ, and especially by its remarkably broad, thick indusia, which are pressed over and entirely conceal the sporangia.

A. horizontale Baker.—Tenompok, in forest (Cl. 29266).

The specimen agrees closely with the type from Sumatra (Hancock 59, Kew) in size, shape, colour, texture and horizontal position of the pinnæ, which however are more numerous (up to 11 pairs), truncate or the lower ones subcordate, and short-stalked, not cordate and overlapping the rachis; they are also practically glabrous (without scales).

A. tenerum Forst.—Kamborangah, epiphyte on mossy tree by river (H. 25537), falls above Lumu (Cl. 29970), Tenompok (Cl. 28361, 29549), Silau basin at 7,000 ft., on rock by stream (Cl. 29091). These are the common Malayan form with acuminate pinnæ and often bud-bearing rachis.

var. **retusum** C. Chr. var. nov. The apical teeth are very small, and the terminal one often entirely missing; the pinnæ therefore have truncate or even retuse tips, and are about of the same width from base to apex. The plant looks in habit quite different from the form with acuminate pinnæ, but agrees with it in all important characters. Near Menetendok, on rocks by stream (H. 25586), Dallas—Tenompok spur (Cl. 27746).

This variety is very common in the Malay Peninsula, and in the south at least is probably more common than the typical form. Somewhat intermediate specimens also occur. (R. E. H.).

A. Klossii C. Chr. n. sp. Rhizomate breviter repente vel adscendente, paleis fuscis, ovato-acuminatis, subpeltatis, integris vel sub apice sparse dentatis vestito. Stipitibus fasciculatis, ut rachi griseoviridibus, glabris, supra leviter trisulcatis et paleis minutes obsitis, inferne teretibus nudisque, 15–20 cm. longis. Lamina late lanceolata, ad 35 cm. longa, 15 cm. lata, coriacea, pallide viridi, pinnata, in apicem vel pinnam terminalem caudatam, lobatam, subito contracta. Pinnis 12-13-jugis, horizontalibus, suboppositis, 2.5 cm. inter se remotis, sessilibus (vel inferioribus brevissime petiolulatis), basi cordatis, acutis, maximis 7 cm. longis, 10–15 mm. latis, levissime serrulato-undulatis, infimis vix brevioribus, interdum reflexis, rachi sursum distincte alata, pagina inferiore pinnarum paleis minutis, clathratis, basi stellatim fissis, cuspidatis conspersis. Venis simplicibus, obliques, parallelis; soris a costa fere ad marginem productis, indusiis pallidis, integerrimis. BRITISH NORTH BORNEO: Bettotan near Sandakan (Boden Kloss 18993). Plate 60.

I know only two species with similar cordate pinnæ, namely the Javanese *A. diversifolium* Bl., and *A. horizontale* Bak., both of which differ from A. Klossii by their smaller number of pinnæ and by the end-pinna being like the lateral ones or larger. In *A. Klossii* the terminal pinna is much smaller, deeply lobed or even pinnate below, and prolonged above into a long, nearly thread-like, caudate tip, much as in the variety or subspecies of *A. tenerum* described as *A. productum* Pr. *A. Klossii* also agrees with *A. tenerum* in its rachis being winged above.

A. Belangeri (Bory) Kze.—Dallas (Cl. 30378).

A. normale Don—Gurulau spur (Cl. 10854), Tenompok, common on ground in forest (H. 25423, Cl. 28546, 27192, 27425, 28879, 28165, 29489, 29056), ravine above Dallas (Cl. 26890).

A. borneense Hook.—s.l. (Haviland 1477), Marei Parei ridge (Cl. 10946), below Dallas, on wet shady rocks by stream (H. 25365), Tenompok (Cl. 28364). This species has now been collected also in Sumatra and Perak.

A. unilaterale Lam.—Falls above Lumu (Cl. 29969).

A. filipes Copel. Phil. Journ. Sci. 3c: 34. 1908.—Near Dalls (H. 25146, Cl. 27292, 26894).

This species grows on wet rocks by waterfalls. It is one of the many small-sized subspecies or varieties of *A. unilaterale* Lam. Holttum's specimen agrees with the typical Philippine form, only differing a little in its light red-brown stipe and rachis. New to Borneo.

A. subnormale Copel. in Perk. Frag. 184. 1905.—Dallas, East ravine, rock crevices above river (Cl. 27298).

A. lobangense C. Chr. n. sp. e grege *A. macrophylli* Sw. Rhizomate breve, paleis nigris, lanceolatis, integris onusto. Stipitibus paucis, approximatis, strictis, ad 30 cm. longis, griseo-viridibus vel brunnescentibus, squamulis parvis, ovatis, brunneis, pellucidis (cellulis sat magnis), sparse lacerato-fimbriatis cum rachi sat dense paleaceis. Lamina lanceolata, ca. 30–40 cm. longa, 10–16 cm. lata, papyracea vel firmiter herbacea, colore brunnescente, pinnata, apice gemmam squamulosam nascente. Pinnis ca 12-jugis, alternis, 3.5 cm. inter se remotis, breve (2–3 mm.) petiolulatis, maximis 9 cm. longis, 1.5 cm. latis, infimis vix reductis, basi postice breve cuneatis antice truncatis, non auriculatis, acutis vel breve acuminatis, marginibus integris vel indistincte et remote dentatis, superne glaberrimis, inferne squamulis minimis laceratis brunneis conspersis. Venis 9-10-jugis, valde obliquis, plerisque bis furcatis, distinctis. Soris remotis, seous ramos acroscopicos venarum fere a costa ad marginem productis, ergo valde obliquis et sæpe arcuatis, indusiis læte brunneis, integerrimis.

KINABALU: near Lobang, terrestrial, on steep rocky slope in forest (H. 25548, type in Herb. C. Chr.).

This new species somewhat resembles *A. paradoxum* Bl., but is quite different by its much smaller pinnæ, remote sori and scaly stipe and rachis. It is more closely related to *A. Sancti Christophori* Christ (syn. *A. Gjellerupii* v. A. v. R.) from New Guinea, which is nearly the same and shows the same essential characters, but its pinnæ are much shorter and broader at their base, being trapezoideo-triangular in outline, and more distinctly dentate.

The leaf of *A. lobangense* seems always to terminate in a scaly bud; this bud is sometimes sessile and apparently lateral at the base of a terminal pinna, sometimes stalked and apparently terminal.

A. porphyrorachis Baker Journ. Bot. 1879: 40. Ic Plant. 1650. *Diplazium* Diels, C. Chr. Index; *Athyrium* Copel. Keys 379.—*Polypodium subserratum* Hook. 1862 (not *Asplenium subserratum* Bl. 1828).—Tenompok, edge of forest, on ground (H. 25379, Cl. 29437, 28238).

This species, which is common in Borneo, is extremely near the following, chiefly differing in being pinnatifid only, and by the segments being fertile from base to tip with the basal sori occasionally diplazioid. Retaining *A. fuliginosum* in *Asplenium,* it is unnatural to place this species in *Diplazium;* further, *A. porphyrorachis* is in many characters very near *A. pellucidem, A. longissimum* and other allied species. *Athyrium Merrillii* Copel. from Mindoro and Papua is hardly different.

A. fuliginosum Hook.—Marei Parei spur at 7,000 ft. (Gibbs 3109, *Trichomanes javanicum* Gepp), Near Kamborangah, on rocks near river(H. 25529), s.l. (Low), Silau basin at 7,000 ft. by forest stream (Cl. 29749).

Holttum's specimens match the type perfectly (*see* Hook. Sec. Cent. pl. 3). This is larger than the former species (the leaf 80 by 12 cm.), fully pinnate in the lower two-thirds, the pinnæ acuminate, fertile in the outer half only; scales, dark colour and texture as in *A. porphyrorachis.*

A. adiantoides (L.) C. Chr.—*A. falcatum* Lam., Copel. Keys 384.—Kiau (Tp. 1571).

A. nigrescens Bl. v. A. v. R. Bull. Jard. bot. Buitenz. II ser. no. I: 3, pl. 1 f. 4.—Marei Parei ridge, epiphyte (H. 25615), falls above Lumu (Cl. 29972).—Sarawak: Mt. Murud (Mjöberg.).

Holttum's specimen is identified by comparison with the illustration quoted, and with specimens named by Copeland. Copeland considers *A. nigrescens* doubtfully different from *A. contiguum* Klf., but in this I do not agree. Our plant is much larger than the genuine *A. contiguum* from Hawaii, and the sori not nearly so close and parallel to the costa. I am not at all sure that the true *A. contiguum* occurs in Malaya.

A. acutiusculum Bl.—Lobang to Kiau (Tp. 1814), Tenompok, on trees and rocks by stream (H. 25402, Cl. 26646, 28054, 26829), Dallas-Tenompok ridge (Cl. 27604, 26889), Bundu Tuhan (Cl. 28052).

The lower pinnæ of most fronds have a large free auricle at the upper base, and the rachis is usually bulbiferous near the apex.

A. planicaule Wall. ? —Lobang (Tp. 1773), Dallas-Tenompok and Silau basin (Cl., both s. n.).

Copeland named Toppings's specimen *A. falcatum* var., but it can hardly belong to that species. It is small, with pinnæ not more than 2 to 2.5 cm. long and rather deeply lobed.

A. malayo-alpinum Holttum n. sp.—Rhizomate tenue longe repente, paleis dense vestito; paleis purpureo-brunneis,

tenuibus, ca. 6 mm. longis, basi haud 1 mm. latis, apice acuminatis filiformibus, non dentatis. Stipitibus inter se haud 1 cm. remotis, tenuibus, pluribus ca. 12 cm. longis, maximis 25 cm., fuscis, basin versus paleis ut rhizomate vestitis. Lamina 8–16 cm. longa, 3–5 cm. lata; in sicco fusca; pinnis omnibus oblique adscendentibus, ca. 6-8-jugis infra apicem pinnatifidam; pinnis infimis 2-3-jugis subæqualibus, oppositis vel alternis, ad 4.5 cm. longis, 1.5 cm. latis, basi postice anguste antice late cuneatis, basin versus pinnatis, pinnulis liberis 1-3-jugis; apicem versus angustatis lobatis, lobis angustis apice anguste dentatis; pinnula basale acroscopica maxima, anguste elliptica vel anguste obovata, apice rotundata anguste dentata; pinnulis ceteris multo angustioribus; textura tenuiter coriacea, marginibus pinnarum in sicco involutis; rachi costisque inferne paleis parvis angustis ut rhizomate munitis. Soris 2 in segmentibus basalibus acroscopicis, in segmentis ceteris solitariis; soris distalibus longis subparallelis, maturis paginam totam tegentibus.

KINABALU: at 12,500 ft, in crevice of overhanging rock (H. 25485, type in Herb. Singapore), Pakka to Low's Peak (Tp. 1697, Cl. 10647). Plate 61.

LUZON: Mt. Pulog, Benguet, 2,400 m, Pterid. Philip. Exsic. 170, distributed as *A. cuneatum*. Celebes: Bonthain Peak, 10,000 ft. (Everett 85, in Herb. Singapore). Java: G. Pangerango (in Herb. Bog. as *A. praemorsum*).

This species is quite different from *A. cuneatum* (a West Indian species) and its allies, but is closely related to *A. praemorsum* Sw., from which it differs by its creeping rhizome covered with thin castaneous lanceolate finely acuminate entire, not clathrate, scales. Several very similar species occur in Africa. *A. malayo-alpinum* is closely related to a species described from Perak (*A. perakense* Matt. and Chr., Journ. Linn. Soc. Bot. 39: 214. 1909), but is distinct in its long-creeping rhizome, densely covered with scales, its relatively few pinnæ which are obliquely ascending, the lowest not deflexed, in the shape of the lowest acroscopic pinnules, and in the finely toothed pinna-lobes. *A. perakense* was found in forest at much lower altitudes than the 10,000 feet level at which *A. malayo-alpinum* occurs. The specimens from the various mountains quoted are closely similar. The very closely placed rhizome scales make the rhizome appear much larger than it really is; its actual diameter is 2 mm., and the scaly covering increases this to 8 mm.

A. kinabaluense Holttum n. sp.—*A malayo-alpino* similis, differt: paleis latioribus apice non filiformibus, frondibus triangularis, pinnis infimis maximis, latioribus,

profunde dissectis, pinnis sub-basalibus haud adscendentibus, pinnulis basalibus acroscopicis late cuneatis profunde lobatis, costis inferne paleis latis munitis.

Rhizome slender long-creeping, clothed with castaneous scales; the scales thin, about 1.5 mm. wide at the base, narrowed to an acute but not filiform apex, to 6 mm. long; stipes slender, dark brown, at the base scaly like the rhizome, about 8 to 14 cm. long; lamina narrowly deltoid, to about 14 cm. long and 7 cm. wide, the lowest pinnæ largest, slightly ascending, upper pinnæ usually nearly horizontal; lowest pinnæ about 4–5 cm. long and 2.5 cm. wide, deltoid, dissected into separate pinnules almost to the apex, the lowest pinnules broadly cuneate and dissected almost to the costa into several lobes, the lobes subentire or shortly incised into a few teeth; the upper pinnæ progressively smaller and less dissected; texture thinly coriaceous; colour dark; rachis and costæ beneath rather copiously provided with scales similar to those on the rhizome but smaller (*i.e.*, relatively broad thin scales, not hair-pointed); sori long, several on each pinnule, when mature almost covering the lower surface.

KINABALU: base of Victoria Peak, 13,000 ft. (Cl. 29830, type in Herb. Singapore). Plate 62.

This species is clearly distinct from *A. malayo-alpinum* in the points mentioned in the Latin diagnosis. Its rhizome is less thickly clothed with scales, and so appears more slender (about 4 mm. including the scaly covering); the scales are quite different in shape, and the frond is a different shape and more deeply dissected. The fronds are more like those of *A. Elmeri,* but from this species it is clearly distinguished by the long-creeping rhizome, and by the broad scales on the under side of rachis and costæ.

A. spathulinum J. Sm., C. Chr. Gard. Bull. S. S. 4: 400. 1929.—*A. affine* p.p. auctt., Copel. Keys 385.—Below Dallas, on rocks by stream (H. 25364, Cl. 28038, 26924), Tenompok (Cl. 27769, 28689, 29418).

This has usually spathulate-cuneate pinnules which in larger leaves may be more or less incised.

var. **amaurolobum** Rosenstock in Herb. (pro specie).—Menetendok, on rocks and trees by stream (H. 25582).

The pinnules are roundish obtuse, slightly or not at all incised, at the base cuneate on the inner side, parallel to the costa and obtusely subauriculate on the outer one. The extreme forms of this variety look rather different from the type, but intermediate forms occur; thus the larger leaf of no. 25364 is very typical, but the smaller one is more like the variety, which has been found in several places in Borneo.

A. Elmeri Christ—*A. laserpitiifolium* Bak. 1894: 252.—s.l. (Haviland), Pakka cave, on trees near stream (Tp. 1677, H. 25502), Tenompok (Cl. 28641), below Pakka, on ridge (Cl. 27964, 27057), Silau basin at 7,000–8,000 ft. (Cl. 29711), Low's Peak (Cl. 27046).

A. dichotomum Hook.—s.l. (Low, Burbidge, Haviland 1494), Kiau to Lobang (Tp. 1598), Lobang, on rock in forest (H. 25551), Dallas-Tenompok ridge, on rock by waterfall (Cl. 27737), Silau basin at 5,000 ft. (Cl. 29305).

BLECHNUM Linn.

The four or five species of the subgenus *Lomaria* found on Kinabalu are an interesting instance of an Australian element in the Malayan flora.

B. fluviatile (R. Br.) Lowe—Kamborangah to Pakka, 9,000 ft. (Cl. 28727), above Pakka, under great slanting rock, 12,000 ft. (Cl. 27044), Low's Peak, between rocks (Cl. 27047).

A most interesting and unexpected find in Malaysia of a species hitherto known only from the southern temperate region (Australia, Tasmania and New Zealand). The Kinabalu specimens agree closely with the common New Zealand form in division, scaly stipes and rachis, short and broadly obtuse sterile pinnæ, and in the narrow fertile frond with ascending short pinnæ. Some plants match exactly the figure of *Lomaria rotundifolia* Raoul, Choix de Plantes Nouv. Zel. pl. 2B. The specimens are perhaps smaller than the average size of the species (those from the summit are particularly dwarfed), and of a harsher texture, probably due to the exposed localities of high altitude.

B. Patersonii (R. Br.) Mett.—Lobang (Cl. 10352), near Kamborangah, on rocks by river (H. 25528), Silau basin, rocks in river bed (Cl. 29031).

In shape and cutting typical, but pinnæ numerous (up to 12 pairs), the sterile ones up to 20 cm. long by 2.5 cm. wide, the fertile 12 cm. by 4 mm.

B. procerum (Forst.) Sw.—*B. capense* p. p. auctt., Index.—Marei Parei spur (Cl. 11055).

I am now sure that this Australian-Malayan species cannot properly be united with the South African *B. capense* (L.) Schlecht. Before the whole complex of forms of this group is revised thoroughly I dare not decide if the Kinabalu form and others from Borneo are rightly referred to *B. procerum*, but they are at least closely related to the type. *B. capense* Gepp p. 201 (Gibbs 4309) from the summit of Kinabalu may be this, but is more probably the next species.

B. vestitum (Bl.) Kuhn.—Tenompok to Lumu Lumu, in ridge forest (H. 25443), Kamborangah, low forest (Cl. 28883), s.l. (Cl. 27755).

Much more scaly than the specimen referred to *B. procerum,* but otherwise scarcely different, and it is not improbable that both belong to the same species.

B. Fraseri (Cunn.) Luerss. var **philippinense** Christ, Bull. Herb. Boiss. 6: 149, pl. 2 (sub *Lomaria*)—Marei Parei ridge (Cl. 11032, H. 25612).

A small tree fern with an erect stem nearly 1 m. high, somewhat more robust than the type from New Zealand. *B. Fraseri* var. *novoguineensis* Brause (Engler's Bot. Jahrb. 56: 159. 1920) is to me the same.

B. orientale Linn.—Bridle path to Dallas (H., s.n.), Dallas (Cl. 26477).

This species is exceedingly abundant all along the bridle paths up to 3,000 ft. altitude or more. Cl. 26477 is bipinnatifid.

B. Finlaysonianum Wall.—Tenompok, on high ridge (Cl. 28728, 29492), Kamborangah (H., s.n.).

A forest species, always growing in shade. It is rather common in lowland forest in the south of the Malay Peninsula, but on Kinabalu was nowhere abundant and I only saw it two or three times. Its occurrence at nearly 7,000 ft. altitude is interesting.

PITYROGRAMMA Link.

P. calomelanos (L.) Link, Hdb. Gew. 3: 20. 1833.—Dallas, thicket above stream (Cl. 27036).

SYNGRAMMA J. Smith.

S. alismifolia (Pr.) J. Sm.—Marei Parei spur (Tp. 1868).

CONIOGRAMME Fee.

C. fraxinea (Don) Diels, Hieron. Hedwigia 57: 286. 1916.—Near Dallas in forest by stream (H. 25277). Recorded by Copeland, Keys 329, but I have seen no specimen.

A form with only the largest pinnæ pinnate at the base, otherwise simply pinnate with pinnæ 25–30 cm. long by 5 cm. wide and very like the following species, but venation different. The veins end in a clavate straight hydathode which is separated from the entire thin margin by a layer of mesophyll.

C. macrophylla (Bl.) Hieron. l.c. 291, var. **Copelandi** Hieron. l.c. 292.—Near Menetendok, in forest by river (H. 25588), Dallas (Cl. 27227). New to Borneo; the type is from Java, the variety from the Philippines.

Always (?) simply pinnate; the veins end in a thick, somewhat arcuate hydathode which is connected with the broad cartilaginous margin by sclerenchymatous cells; otherwise the species is hardly different from the former.

CHEILANTHES SWARTZ.

C. tenuifolia (Burm.) Sw.—Koung to Kabayau, bank of bridle path (Cl. 27678).

ADIANTUM LINN.

A. diaphanum Bl.—Lobang, abundant on rocks by edge of stream (Cl. 10327, 10358, H. 25553), Dallas-Tenompok, on bank by path (H. 25290, Cl. 27513), Tenompok (Cl. 26982, 28360), falls above Lumu, in cave (Cl. 29462), Menetendok gorge (Cl. 29385).

PTERIS LINN.

P. vittata L. Hieron. Hedwigia 54: 290. 1914.—*P. longifolia* auctt. ex parte, Copel. Keys 332.—Lobang (Cl. 10323).

P. rangiferina Pr. var. **scabripes** n. var.—Stipe 50 cm. or more long, scabrous with numerous small raised points, especially towards the base. Sterile pinnæ 5 to 8 pairs, 10–15 by 2–3 cm., with a distinct cartilaginous margin, coriaceous, pale green; fertile pinnæ 1 cm. wide. Marei Parei ridge (Cl. 11062), Penibukan ridge (H. 25621).

P. Dalhousiæ Hook.—Above Tenom (Gibbs 2878).

Copeland suspected that Gepp had named Gibbs 2878 wrongly, but the specimen in the British Museum is no doubt a small form of this species.

P. ensiformis Burm.—Kiau (Tp. 1558), below Tenompok (Cl. 29028), Dallas-Tenompok ridge, bank by path (Cl. 27485), Koung to Kabayau, on rocks by path (Cl. 27690).

P. Grevilleana Wall.—*P. quadriaurita* var. *digitata* Bak. 1879: 40.—s.l. (Burbidge), Kiau to Lobang (Tp. 1605), Lobang, on rocky slope in forest (H. 25556), Tenompok (Cl. 28172).

P. longipinnula Wall.—*P. Toppingii* Copel. 1917: 47.—Kota Belud to Kabayau (Tp. 1488).

The type specimen of Copeland's new species is identical with a specimen from Pahang (Bentong, I. H. Burkill 16700, Herb. Singapore), which I have compared with Wallich's type at Kew.

P. Clemensiæ Copel. 1917: 47.—Lobang (Cl. 10348, H. 25722), Tenompok (Cl. 27909, 28095, 29311).—Sumatra: G. Tandikat (Matthew 951).

Doubtfully different from *P. longipinnula;* the segments are closer and narrower.

P. flava Goldm. Hieron. Hedwigia 55: 337. 1914.—*P. quadriaurita* ex parte auctt., Copel. Keys 334; an Gepp p. 202 ?—Kamborangah, in valley forest, frequent near stream (H. 25521).

This agrees with the Philippine type in its stramineous rachises and light green leaf, differing somewhat in having fewer veins (10–13 pairs; in the type 20–22). Taking the species of this group in the same narrow sense as Hieronymus did, this form would be a new species.

P. biaurita L.—Koung to Kiau (Tp. 1505), Kiau (H. 25595), Dallas (Cl. 27213, 27068). In open ground, especially on the edge of cultivation.

P. purpureorachis Copel. 1917: 48.—Lobang (Cl. 10350, Tp. 1790), Tenompok, occasional in forest (H. 25413, Cl. 28093), Dallas-Tenompok spur, in forest (Cl. 27730).

P. excelsa Gaud.—Kiau (Tp. 1538, 1568), below Dallas, on rocks by stream, in shade (H. 25275), Tenompok trail, on wet bank (Cl. 27118).

Copeland believed this to be an undescribed species, but I cannot find any essential difference between the specimens quoted and the Asiatic fern usually called *P. excelsa.*

P. decussata J. Sm.—s.l. (Low), Kiau to Lobong (Tp. 1613), Lobang, rocky place near stream (H. 25558).

P. longipes Don. var. **philippinensis** (Fée) C. Chr. ?—*P. philippinensis* Fée 10e Mém. 17, t. 33 f. 2; C. Chr. Index.—Near Menetendok, in forest near river (H. 25569), Dallas, east ravine (Cl. 27289).

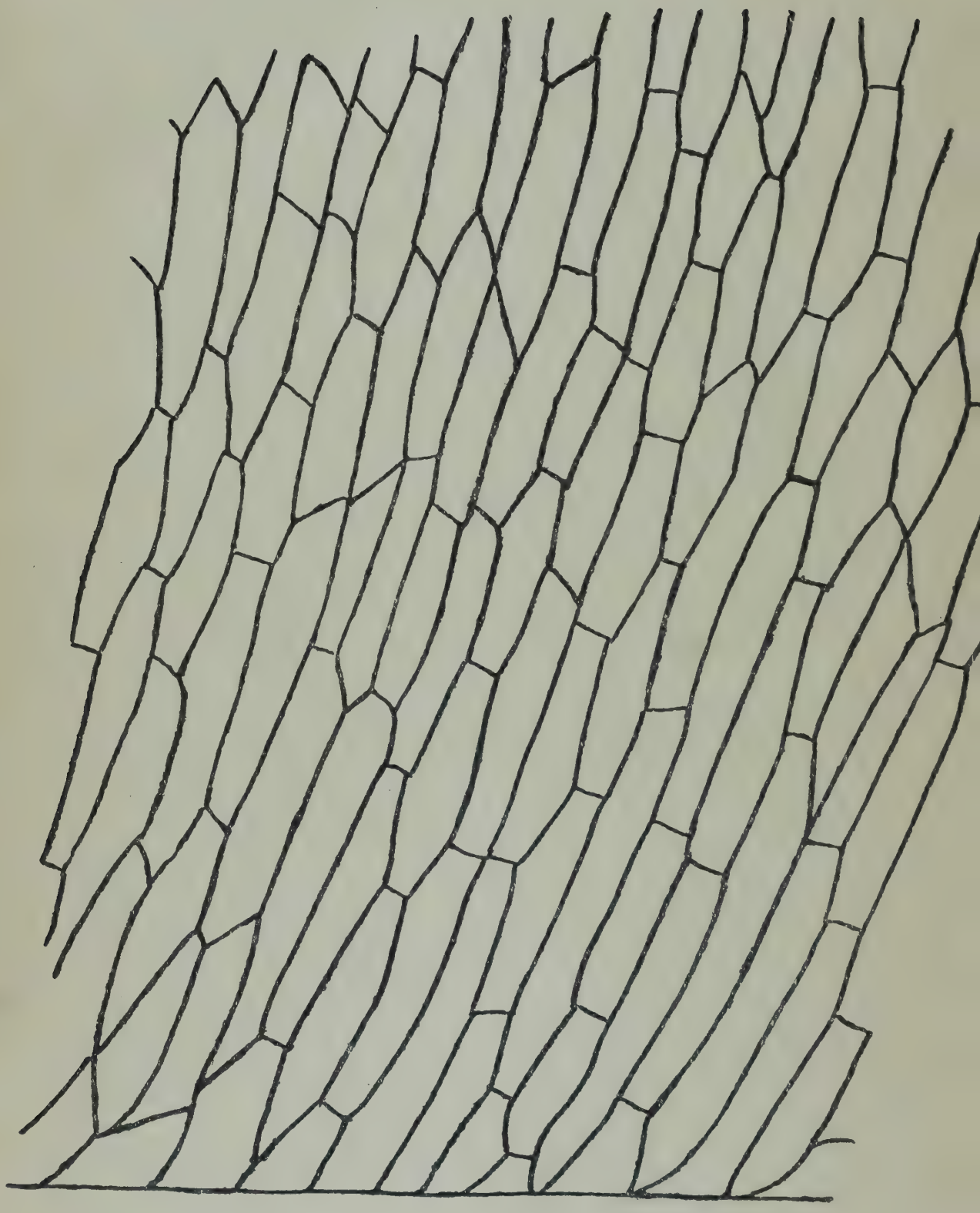
New to Borneo. Identical in almost all characters with the Himalayan type, but in Holttum's specimens (which are fully fertile) the basal pinnæ are bifurcate only, not fully pinnate, thus better agreeing with *P. quadriaurita* and its relatives, from which it is otherwise quite different. The pinnæ are short-stalked and long-caudate just as in Fée's species (Cuming no. 8), which I suppose to be very nearly the same. Clemens 27,289 has the basal pinnæ with two or three lateral branches on the lower side, the frond more broadly deltoid.

P. kinabaluensis C. Chr. n. sp.—*Eupteris* sect. *Tripartitae, P. longipedi* Don proxime affinis, differt: stipite rachibusque atropurpureis, segmentis integerrimis, apice rotundatis nec serratis, soris impressis, indusiis atrobrunneis.

KINABALU: Marei Parei ridge, in shady forest (H. 25614, type in Herb. C. Chr.), Tenompok (Cl. 29567), falls above Lumu, in gorge by spray of fall (Cl. 29973).

The characters given are quite sufficient to distinguish this pretty species from *P. longipes* and all others known to me. Other characters are as follows. Fertile fronds on longer stalks (60 cm.) than sterile. Basal branches 30–35 cm. long, with about 5–6 pairs of secondary pinnules and a terminal one, the central portion about 50 cm. long with 9 pairs of subsessile pinnæ; pinnæ of the central portion 3 cm. wide, caudate-acuminate, incised into close, slightly oblique segments which are contiguous at their bases, quite entire, 4 mm. wide from the base to the bluntly rounded apex, firm-herbaceous, dark green; costæ deeply channeled above and bearing short spines at the bases of the segments. Veins very distinct, 7–8–jugate in a middle segment, distant, the upper nearly horizontal, all forked with spaced branches, the basal ones running out from the midrib of the segment and their lower branch often forked again near the edge. Sori about 1 cm. long, occupying the lower half or two thirds of both sides of the segments but not reaching the bottom of the sinus, impressed so that the upper side of the segment over them becomes vaulted; indusia entire and like the sporangia of a dark red-brown colour.

P. Holttumii C. Chr. n. sp.—*Litobrochia* rhizomate horizontaliter repente, 2 cm. crasso, lignoso, angulato, paleis perparvis, brunneis, exterioribus vix ultra 1 mm. longis, opacis, ovato-lanceolatis, interioribus multo minoribus, castaneis, lanceolatis vel subpiliformibus dense obtecto, radices tenues e lateribus emittente, a basi stipitis ramum brevem nascente. Stipite fere metrali, griseo-stramineo, ut toto folio glaberrimo sed parte inferiore (1 cm. crasso) squamulis parvulis adpressis mox abrasis vestito, aculeis conicis, rectis, 2 mm. longis vel multo minoribus muricatis. Lamina usque ad 2 m. longa, herbacea, pallide viridi, pinnata; rachi straminea, parte inferiore sparse muriculata. Pinnis multijugis, alternis, inferioribus 60 cm. vel ultra longis, 7 cm. latis, superioribus sensim minoribus, suprema 15 cm. longa, 2 cm. lata, cum terminale æquale subconfluente, infimis 10 cm. inter se remotis, omnibus sessilibus, lineari-lanceolatis, integerrimis, acuminatis, basi inæqualibus, antice rotundato-truncatis et interdum rachin tegentibus, postice breve rotundato-cuneatis et (superioribus solum) ad rachin adnatis; costis stramineis, superne sulcatis, subtus validis, prominentibus. Venis distinctis, more *Acrostichi aurei* dense reticulatis, areolas 8-10-seriatas, 4-6-gonales, elongatas, ca. 2–3 mm. longas 0.8–1 mm. latas formantibus, omnibus similibus, tenuissimis. Pinnis inferioribus



PTERIS HOLTTUMII. Venation, × 3.

sterilibus, medialibus et superioribus fertilibus, soris ex earum basi fere ad apicem continuis, maturis 2 mm. latis, indusiis scariosis, atrobrunneis, integris, angustis.

KINABALU: below Dallas, in wet ground by stream (H. 25363, type in Herb. C. Chr., Cl. 27229).

This splendid new species, which I dedicate to its collector, is the finest novelty discovered in recent years; it is of great interest, and should perhaps be the type of a new subgenus. Among the Malayan species it can only be compared with *P. Warburgii* Chr. (*P. finisterrae* Ros.) from Amboyna and New Guinea, but this has subdimorphous, deeply pinnatifid, not truly pinnate fronds, and the areoles are much larger. In size, division, and venation, our new species shows a remarkable resemblance to *Acrostichum aureum*, and this strongly supports the hypothesis that *Acrostichum* is derived from the *Pterideae*.

HISTIOPTERIS J. SMITH.

H. incisa (Thbg.) J. Sm.—s.l. (Haviland 1492), Pakka (H. 25519, Cl. 28972, 28018), Silau basin, rocks in river bed at 7,000 ft. (Cl. 29032).

H. stipulacea (Hook.) Copel. Phil. Journ. Sci. 3C: 347. 1909.—Tenompok, clearing by path (H. 25414, Cl. 28362).

var. **integrifolia** (Copel.) C. Chr. *H. integrifolia* Copel. l.c. 7C: 63. 1912.—Kiau (Cl. 10227), Gurulau Spur (Tp. 1623), Tenompok (Cl. 28268).

The type of this form looks distinct enough, but I have seen too many intermediates between it and *H. stipulacea* to regard it as a distinct species; moreover, I am by no means sure that both may be separated with certainty from *H. incisa*.

ELAPHOGLOSSUM SCHOTT.

E. Beccarianum (Baker) C. Chr.—Lumu Lumu to Kamborangah, on trees on the ridge (H. 25454, part).

In a former paper (Mitt. Inst. allg. Bot. Hamburg 7: 164), I made this a variety of the Peninsular *E. Norrisii* (Hook.) Bedd., and perhaps I was right. Both are very alike in most characters, *e. g.* the soft, light or reddish brown rhizome scales and the long-decurrent subsessile leaves, which however are oblanceolate and usually obtuse in *Beccariana*, lanceolate and acute in *Norrisii*.

E. callifolium (Bl.) Moore—Tenompok, on fallen tree (H. 25412, Cl. 29332, 28639).

This is the first certain collection of the species in Borneo, though a specimen from Dutch Borneo (Hans Winkler 960 a) may belong here.

E. decurrens (Desv.) Moore.—Tenompok to Lumu Lumu (H. 25427), Lumu Lumu to Kamborangah (H. 25454, part; 25717, 25718, Cl. 27060, 28019).—

SARAWAK: Mt. Matang (Ridley, Jan. 1915, Kew). New to Borneo.

Ridley's specimen and H. 25427 (a small one) from lower altitudes agree very well with Blume's plate 10, *i.e.* the fertile frond is much smaller than the sterile ones which are distinctly decurrent on the stipe, the rhizome scales are reddish brown, soft and sparsely fimbriate, the texture more or less coriaceous, the under side not glossy. Specimens from higher altitudes on Kinabalu look rather different, especially no. 25718. This is a large form: blade of the sterile frond up to 40 by 6 cm., oblanceolate, short-cuneate but hardly decurrent at the base, very thickly coriaceous, of a beautiful light leather-brown colour and glossy beneath when dried, the costa flat beneath, 5 mm. broad below, the veins quite hidden, the stipe 8–12 cm. long. Fertile blade on a longer stipe, elliptical, 20 by 5 cm., abruptly rounded at the base. The smaller specimens, nos. 25454 and 25717, belong to the same form but their decurrent fronds are so near the type that I dare not now segregate this Kinabalu form as a species: it can perhaps be made a variety, var. *crassum*.

I may add here that *E. Cumingii* (Fée) Moore, united by most authors with *E. decurrens*, is to me a distinct species, marked by the leaves being densely fringed with rufous scales; no trace of such marginal scales are to be found in *E. decurrens*. A close relative of this is *E. permutatum* v. A. v. R. Bull. Jard. bot. Buitenz. II ser. XVI: 13. 1914 (Sumatra: G. Sago, Matthew 696), which differs in its elliptical, acuminate and hardly decurrent sterile leaves of rather thin texture, and in its very long-stalked fertile leaves, the lamina of which is 7 cm. long by 1.5 cm. wide only, and not decurrent. Intermediate between *E. permutatum* and *E. decurrens* is a specimen from G. Tahan, Pahang (H. 20750), the sterile fronds of which are typical *decurrens* but the fertile ones are like *permutatum*.

E. angulatum (Bl.) Moore—*E. laurifolium* auctt. Copel. Keys 411.—Pakka, on trees near stream (Cl. 10719, H. 25508, Cl. 28020).

Differs from the former species by the wide-creeping rhizome, which is clothed with broad ovate, reddish brown scales; similar scales are scattered along the stipes and costa beneath. The leaves are uniform, the stipes up to 10 cm., articulated to dark-coloured pseudopodia 1 cm. long, the lamina to 15 by 2.5 cm., narrow-elliptical, equally short-attenuate to both ends, the cartilaginous margin broad and

wavy, texture coriaceous, the under side bearing scattered minute scales. I am sure that my determination is right; the specimens agree excellently with Blume's plate 6 and also with Fée's figure (Acrost., pl. 7), but this Malayan form is scarcely identical with the genuine *Acrostichum laurifolium* Thouars from Tristan d'Acuna. *E. laurifolium* Christ and v. A. v. R. is; at least partly, *Acrostichum commutatum* Mett. (*A. conforme* Bl. pl. 5) a very similar plant with a shorter rhizome and not unlike typical *E. conforme;* but I am by no means sure that the two "species" illustrated by Blume are really different.

E. petiolatum (Sw.) Urban, sens. lat., var.—Tenompok, on large tree (H. 25357), falls above Lumu (Cl. 29709), Silau basin (Cl. 29064).—
SARAWAK: Mt. Murud (Mjöberg).

I have little doubt that the Asiatic forms usually referred to *E. petiolatum* are specifically different from the American and African ones, and moreover that they belong to more than one species, but I am not able at present to unravel these intricate forms. The Bornean specimens under examination differ from most others in the character of the scales on the lower surface of the sterile fronds. These scales are more numerous, peltate and nearly circular, with short cilia (in most other forms of the species the scales are fewer and stellate, with a very small disc and long arms). The upper surface is naked beyond the costa, but in the fertile frond densely matted with rufous fimbriate small scales. The stipe of the sterile frond is 13–15 cm. long, the lamina lanceolate or linear-oblong, 25–30 by 3–3.5 cm. The stipe of the fertile frond is 20 cm. long, the lamina linear, 20–30 by 1–1.2 cm. The rhizome is creeping, the scales narrow, linear-lanceolate, castaneous, the stipes about 1 cm. apart.

SCLEROGLOSSUM v. A. v. R.

In my monograph of this genus (Dansk Bot. Arkiv 6 no. 3: 25. 1929) I tried to distinguish a small number of closely related species, which I fear cannot all be maintained as good ones.

S. debile (Kuhn) v. A. v. R., C. Chr. l.c. 26, pl. 2.—Marei Parei ridge, on mossy tree trunk (H. 25613).

A doubtful form with very narrow leaves (under 1.5 mm. wide) and interrupted, slightly immersed sori; in size and habit like a small *Monogramma.*

S. pusillum (Bl.) v. A. v. R., C. Chr. l.c. 27, pl. 2.—Pakka to Lobang (Cl. 10722), Marei Parei ridge (H. 25179), Lumu Lumu to Kamborangah (H. 25464), Lumu to Pakka (Cl. 28982; 29104).

var. **angustissimum** (Copel.) C. Chr. l.c. 28, pl. 2. *S. angustissimum* Copel. 1917: 65.—Marei Parei ridge (Cl. 11048), Kamborangah (Cl., s.n.).

S. **minus** (Fée) C. Chr. l.c. 29, pl. 2.—Kamborangah (H. 25542).

New to Borneo. A form with thick narrow rush-like leaves; it differs from the former species by the marginal sorus-grooves. Perhaps it is not really different from the following species.

S. **sulcatum** (Kuhn) v. A. v. R., C. Chr. l.c. 28, pl. 2.—Pakka (Haviland 1481, Cl. 10722, H. 25736), above Pakka, on rocks (Cl. 27998).

OREOGRAMMITIS Copeland 1917: 64.

O. Clemensiæ Copel. l.c., C. Chr. Dansk. Bot. Arkiv 6 no. 3: 30, pl. 3.—Low's Peak (Cl. 10618 p.p.), under an overhanging rock at 13,000 ft. (H. 25484).

Certainly a distinct species, but the validity of the genus is very problematical.

POLYPODIUM Linn.

The genus is here taken in the wide sense of the Index, though it is, in my opinion, a tribe, not a genus. The problem of splitting it up into well defined and natural genera is, however, beset with many difficulties which have still to be overcome. In his paper on the Oriental Genera of Polypodiaceæ (1929), Copeland proposes to restore a number of old genera, but I am not quite satisfied with his treatment.

Series I. Species with all veins free

Grammitis (Swartz).

P. kinabaluense Copel. 1917: 60.—Pakka to Low's Peak (Cl. 10649, 10618 part), Pakka, in rock crevices and on a tree (H. 25483, 25745, 25873, Cl. 27990, 27783).

A small, glabrous species with densely tufted, subcoriaceous, oblanceolate or spathulate leaves and somewhat impressed sori. The best character, overlooked by Copeland, is found in the sporangia, which when young are furnished with 2–5 red-brown setæ, which entirely cover the young sori; these setæ soon fall and are sometimes lacking in old sori. By this character the species differs from *P. universe* Baker, which is smaller, with the naked sporangia mixed with long hairs.

P. malaicum v. A. v. R. Handb. Mal. Ferns 577. 1909.—*P. sessilifolium* Hook. Spec. Fil. 4: 168 pl. 268A. 1863 (not. Liebm. 1849).—Kamborangah to Pakka (H. 25479, 25744), Menerintog (Cl. s.n.).

I have little doubt that this determination is right, though the young sporangia are setose with the setæ clustered at the apex, which character has never been mentioned for the species; the setæ however fall early and are not to be found on mature sporangia. Specimens from Luzon (Copeland: Pterid. Philip. exsic. 141, *P. sessilifolium*) agree well with Hooker's figure, but have setose sporangia like the Kinabalu fern. The species, which is also known from the Peninsula, is closely related to *P. kinabaluense*, differing in its thinner, nearly herbaceous texture and larger size; the largest leaves are 12 cm. long by 4–5 mm. wide (those of *P. kinabaluense* are 4–5 cm. long, most being much smaller). The leaf margins are more or less repand-sinuate, and most of the veins are forked. The species has often (as in my Index) been united with *P. subevenosum* Bak., but this has apparently naked sporangia and most veins simple. *P. Maxwellii* Bak. from Sarawak seems to be quite identical with *P. subevenosum;* the name *P. Maxwellii* cannot therefore be substituted for the invalid *P. sessilifolium* Hk. as suggested by Copeland (Keys 393).

P. cæspitosum (Bl.) Mett.—In rock crevices at 12,000 ft. (H. 25496).

New to Borneo. Apparently a rare species, known from Java and Luzon. The few leaves seen are not quite typical, the long thread-like stipe being very sparsely hairy with short hairs, not densely short-hairy as in the Javanese type; in this respect they agree better with a specimen from Luzon (Mt. Pulog; Copel., Pterid. Philip. exsic. 135). A single detached leaf from Kinabalu (H., s.n.), probably belonging to the same form, is exceedingly like the Papuan *P. locellatum* Baker, which differs from *P. caespitosum* by its nearly glabrous stipe and linear, not lanceolate, blade; very likely *P. locellatum* is a form of *P. caespitosum*. These small ferns are easily recognised by their coriaceous, glabrous, lamina, long slender stipe, and deeply immersed oblique and oblong sori.

P. fasciatum (Bl.) Presl; Gepp 203, part.—Below Pakka, erect on mossy rocks in low forest (Gibbs 4265 bis, Cl. 10717; H. 25477, 25870, Cl. 27050, 27059, 28987B, 30462, 27999), Pakka (Tp. 1663, 1718), Silau basin (Cl. 29061).

This is one of the few upright-growing species of *Grammitis*.

P. padangense Baker—*P. durum* Copel. in Elmer's Leaflets 3: 837. 1910.—*P. ciliiferum* v.A.v.R. Bull. Jard. bot. Buitenz. II ser. XVI: 32. 1914.—*P. fasciatum*, part, Gepp 203.—Below Pakka (Gibbs 4272, Cl. 27997, 28987A).

New to Borneo; known previously from Sumatra and Mindanao. I see in my notes that Gibbs 4272 (Brit. Mus.) is exactly identical with Elmer 11689 from Mt. Apo (Herb. Copeland), the type of *P. durum,* which is quite the same as the type of *P. padangense* from Mt. Singgalang, Sumatra, coll. Beccari (Herb. Inst. Bot. Firenze); and Matthew 708 from Mt. Sago, Sumatra, the type of *P. ciliiferum,* is also the same. *P. padangense* somewhat resembles *P. fasciatum* in size and shape of the leaves, but it is more coriaceous, the leaves subsessile and furnished with scattered, soon abraded, blackish bristles along the margins, and *the sporangia are setose.* The short-creeping rhizome is covered with ovate, pale brown, rather large scales.

P. obscurum (Bl.) Mett., v.A.v.R. Handb. 586.—*P. Reinwardtii* var. C. Chr. Index.—*P. ludens* Baker Ann. Bot. 8: 129. 1894.—Pakka (H. 25871).

Also new to Borneo; previously known from Java, and perhaps Papua. This species is very near *P. padangense,* and hardly different as to scales, size, texture, sparsely ciliated margins and setose sporangia, but the lanceolate (not linear) leaves are stalked with a rather densely pilose stipe 2–4 cm. long. The oblique sori are more deeply impressed and borne on nearly linear receptacles, oblong when mature (round in *P. padangense*). The specimen quoted matches the figure of *Grammitis obscura* Blume, Flora Javæ pl. 50, and I am fairly sure that Blume's plant is the same, and that it is not a variety of *P. Reinwardtii* as Mettenius believed. *P. ludens,* from Java (Hancock 53*a*), differs very slightly, having somewhat longer stipes and more acuminate leaves, some of which are irregularly lobed; it can scarcely be considered a variety.

P. dolichosorum Copel. Phil. Journ. Sci. 1 Suppl. II: 159, pl. 16. 1906.—Erect, on mossy rocks by river below Kamborangah (H. 25533).

This species, allied to *P. padangense* and agreeing in hairiness of stipe and frond, oblique sori and setose sporangia, differs markedly in its very long slender creeping rhizome, with rather distant fronds which grow stiffly erect; the dried fronds are also brown and not nearly so dark as those of *P. padangense.* The acroscopic vein which bears the sorus sometimes joins with the vein next above.

P. lasiosorum (Bl.) Hook. ?—Kamborangah to Pakka (H. 26872).

A very doubtful, small form of the group of *P. hirtellum.* It differs from *P. bongoense* and agrees with the Javanese *P. lasiosorum* in its subcoriaceous texture with indistinct veins, and in the setose sporangia. It is almost impossible

to name with certainty the many Malayan species of this group without direct comparison with type-specimens, most of them being imperfectly described.

P. bongoense Copel. Phil. Journ. Sci. 38: 153. 1929 (nom. nov.).—*P. Brooksii* Copel. l.c. 12C: 60. 1917 (not C. Chr. 1913).—*P. lasiosorum* Gepp 203 ?—*P. hirtellum* part Copel. Keys 393 ?—Above Lumu Lumu (H. 25737, Cl. 27996, 28968A), Marei Parei spur (Gibbs 4062?, Tp. 1880?), Tenompok (Cl. 27792).

A. critical species, closely resembling *P. hirtellum* Bl., but the hairs longer and the fertile veinlet very short as in *P. Reinwardtii*. Some of the numerous specimens are however short-hairy like typical *P. hirtellum*. No. 25737 agrees tolerably well with the type from Sarawak; the sporangia are naked as in *P. hirtellum* and the veins somewhat raised beneath. I have noted that Gibbs 4062 (Brit. Mus.) shows the same characters and belongs presumably to this species.

P. Reinwardtii (Bl.) Presl.—Marei Parei ridge (Cl. 11047), Tenompok, pendulous on mossy trees trunks (H. 25399), Kamborangah (H. 25738).

Veins very distinct, subhorizontal, the fertile branch very short, sporangia naked.

P. Reinwardtii var. an sp. nov. ?—Tenompok to Lumu Lumu (H. 25743).

Like the type in size, pubescence and venation, but the sporangia bear a single lateral bristle just as in the Philippine *P. Jagorianum* Mett. (Berlin !); the marginal hairs of that species are however fascicled in groups of 3 to 5, and it is a much smaller species of subcoriaceous texture. *P. Koordersii* Christ from Celebes is, I think, the same. *P. Jagorianum* was evidently misunderstood by Copeland, who distributed under that name a quite different species (Pterid. Phil. exsic. 70), related to *P. hirtellum* but larger and with setose sporangia.

P. Warburgii Christ—*P. pubinerve* Christ, Ann. Jard. bot. Buitenz. 15: 146. Gepp 203. Copel. Keys 394.—Below Pakka (Gibbs 4255), Kamborangah (H. 25741), Marei Parei spur (Cl. 11064), above Lumu (Cl. 27991), Silau Basin (Cl. 29035).

Somewhat resembling *P. Reinwardtii*, but much more robust. Leaves up to 25 cm. long by 1 to 1.5 cm. wide, with red hairs on the midrib and margins only; firm in texture, with the veins raised beneath; all veins very regularly forked at the middle and bearing in addition an acroscopic basal branch which, when fertile (in the upper half of the lamina), is short as in *P. Reinwardtii*. The sporangia are naked, but mixed with a few long hairs.

I cannot say definitely that *P. Warburgii* is the oldest name for this species, but I have little doubt of the identity of the Kinabalu plants with Christ's type from Batjan (Berlin!), and with the Celebes plant called *P. pubinerve* by Christ and later authors. It is, however, certainly not *Grammitis pubinervia* Bl., Fl. Jav. 117, pl. 48, for Blume says expressly that the lateral veins are conspicuous, *but only when the leaf is seen against the light*, and the very distinct *raised* veins are the predominant character of our present species.

P. congenerum (Bl.) Presl.—Marei Parei spur (Cl. 10920 part), Pakka to Lobang (Tp. 1735), Tenompok (H. 25742 ?, a scanty and hardly determinable specimen).

P. setigerum Bl.—Kamborangah (H. 25739).

The specimen agrees exactly with this species as figured by Hooker (Ic. Plant. 941) and as represented by several specimens from G. Gedeh in Java. The rhizome, described by Blume and v.A.v.R. as densely scaly, is so only at the apex, which is covered with small scales; the scales on the older parts of the rhizome, if present, are obscured by the thick mat of long hairs on the closely tufted stipes. The thin leaves, with the branched veins visible only against the light, often have white dots covering the hydathodes on the upper surface. The species is new to Borneo.

P. Havilandii Baker 1894: 253.—*P. multisorum* Copel. 1917: 61.—s.l. (Haviland 1488), Pakka, on mossy tree trunks (Tp. 1665!, 1668, 1682, 1711, H. 25478), Kamborangah (Cl. 27995).

Copeland failed to identify Topping's collection with Baker's species because Baker described the sori as uniseriate, though in the type-specimen at Kew they are distinctly 2–3–seriate; Topping's specimens are exactly identical. The species, known only from Kinabalu, is a most distinct one, especially on account of its peculiar pubescence. The small, short rhizome is apparently scaleless, with numerous fascicled leaves. Stipes 3–4 cm., densely pilose with pale brown, patent, very slender hairs 1–2 mm. long. Lamina (of H. 25478) up to 20–25 cm. long by 1 cm. wide, linear in outline, the edges of the larger fronds rather deeply sinuate-crenate, firmly herbaceous. Upper side, margins, midrib and veins beneath, and receptacles, softly pubescent or subvillous with long pale simple hairs, the leaf-tissue of the under side covered with very short clustered or stellate hairs. Veins indistinct, forked at the apex, bearing one or two pairs of lateral branches which are all fertile; sori in two or three rows but rather irregularly scattered, superficial, completely covered with long hairs; sporangia small, naked. The leaf is often fertile almost to the base.

P. sumatranum Baker.—*P. subpleiosorum* Racib., C. Chr. Index.—Marei Parei spur (Cl. 10920 part), near Pakka, on tree trunks near river (H. 25503), above Pakka, on rocks (Cl. 27065), Silau basin at 7,000 ft. (Cl. 28240).

Rhizome scales light brown, entire; stipes with many short hairs; lamina often deeply lobed, with a few bristles, soon quite glabrous; young sori linear, round when old. The description given by v.A.v.R., Handbook p. 587, is good.

P. calcipunctatum Copel. 1917: 61.—*P. pleiosoroides* Gepp 203.—Kamborangah, abundant on trees near river, pendulous (Gibbs 4141, Cl. 10530, H. 25480, 25532).

A very distinct species which grows much larger than described by Copeland. The smaller forms resemble *P. setigerum* in pubescence and venation, but the sori are different from most species of this group; they are dark brown and densely ciliate. The upper side bears numerous calcareous dots secreted from the hydathodes. H. 25532 is a much larger plant with the same scales, pubescence of long hairs and white dots above. The largest leaf is 40 cm. long by 3 cm. wide and irregularly sinuate-crenate or rather deeply lobed with unequal lobes; it resembles *P. sumatranum* so much that the two might be confused, especially as the older leaves are subcoriaceous and lose their hairs. The different scales and long hairy stipes mark *P. calcipunctatum* clearly when seen in the herbarium; in the field its pendulous habit at once distinguishes it from *P. sumatranum*. The sporangia are setose. The species is known from Kinabalu only.

Calymmodon (Presl).

Copeland has recently restored to generic rank this group of small pinnatifid or subpinnate species (Phil. Journ. Sci. 34: 259-269. 1927). I should not hesitate to adopt this genus if I could see clearly how it may be limited so as to separate it from other small free-veined Polypodia. I prefer for the present to retain the species in *Polypodium*.

P. cucullatum Nees and Bl. *Calymmodon cucullatum* Pr., Copel. l.c. 261.—s.l. (Low), Gurulau spur (Gibbs 4018 bis, a scrap; Tp. 1816, a small form, called by Copeland *P. muscoides*), Kamborangah to Pakka (Tp. 1659, part), Marei Parei spur (Cl. 11044 part), Lumu Lumu to Kamborangah (H. 25732).

var. **subgracillimum** (v.A.v.R.) C. Chr. comb. nov. *P. subgracillimum* v.A.v.R. Bull. Jard. bot. Buitenz. II ser. VII: 40, pl. 3 f. 2. 1912.—s.l., 10500 ft. alt. (Haviland 1482), Gurulau spur (Gibbs 4017), Marei

Parei spur (Cl. 11044 part), Pakka, in mossy forest near stream (Tp. 1713, H. 25500), Dachang (Cl. 29058), Kamborangah (Cl. 28085).

Copeland quoted *P. subgracillimum* as a synonym of *C. cucullatus;* he may be right in regarding the former as not specifically distinct, but it seems to me so different from the form here taken as typical *cucullatum* that I make it a variety. It differs by its much longer and much narrower leaves (up to 20 cm. long by 4–5 mm. wide), with the lower sterile segments tooth-like, and the scales usually less evident. It is glabrous.

P. consociatum v.A.v.R. Bull. Jard. bot. Buitenz. II ser. VII: 41, pl. 4. 1912. Handb. Suppl. 352 (excl. syn.), C. Chr. Gard. Bull. S. S. 4: 403.—*Calymmodon gracilis* (Fée) Copel. l.c. 266.—*Pol. muscoides* Copel. Keys 395, part.—Marei Parei ridge (Tp. 1846), Tenompok to Lumu Lumu abundant on mossy tree trunks (H. 25428), s.l. (Cl. 30461).

This appears to be a common fern in the mossy forests of Borneo and the Philippines, but it is less common in the Malay Peninsula. It is a small species (leaves usually 4–5 cm. long, 5–6 mm. wide), with subequal sterile and fertile segments, pubescent with scattered long pale hairs. The fertile segments of most specimens are not folded, but quite plane with a central sorus. Copeland named Topping 1846 *P. muscoides* Copel., but it fits his own description badly and agrees much better with the present species, though differing in its obscurely sinuate-crenate fertile segments. A new species?

P. clavifer Hook.—s.l. (Low, Burbidge), Marei Parei ridge (Cl. 11043), Kamborangah (Gibbs 4140, H. 25465, Cl. 27065A, 28315, 28000, 28979), Kamborangah to Pakka (Cl. 29104A).

ACROSORUS (Copeland) : Davalliæ sp., C. Chr. Index.

A small group of true polypodioid ferns, quite unrelated to the davallioid genera but near *Calymmodon* and approaching *Prosaptia;* if we retain these two groups in *Polypodium*, we must also make *Acrosorus* a section of that genus.

P. streptophyllum Baker 1879: 42.—*P. triangulare* Scort., *Acrosorus triangularis* Copel. Phil. Journ. Sci. 3C: 347. 1909.—*A. exaltatus* Copel. l.c. 1 Suppl. 159, pl. 15. 1906, *Davallia* Copel. 1905, C. Chr. Index 663, *Polypodium* Copel. v.A.v.R. Handb. 614.—*Davallia Frederici et Pauli* Christ 1895, *Acrosorus* Copel. l.c. 1 Suppl. 159, *Polypodium Sarasinorum* v.A.v.R. l.c. 615.—Lumu Lumu to Kamborangah (Enriquez 18163, H. 25473), Kamborangah (Cl. 27992), Tenompok (Cl. 29506).

After comparison of the four "species" here united, I am convinced that this treatment is correct. Small differences may be pointed out, but these are only such as may be expected within a species of wide distribution. I regard the forms as geographical races. Baker's type from North Borneo (Burbidge, Kew) is apparently identical with *P. triangulare* from the Peninsula, and the Philippine *A. exaltatus* and *P. Sarasinorum* from Celebes are hardly so different that they may be segregated as varieties.

Group of P. denticulatum.

Small pinnatifid or subpinnate species some of which resemble the smaller species of *Colysmodon*, from which they may usually be distinguished by their segments being emarginate or toothed with 1–3 teeth and often bearing 2–4 sori. If a single sorus and a single tooth only are present, they are placed near the base of the segment, which is never folded. The species fall into two (or more?) smaller groups: (1) herbaceous and often glandular-pubescent, (2) rigidly coriaceous and nearly or quite glabrous species. Intermediate species occur, *e.g. P. Matthewianum* v.A.v.R.

P. subpinnatifidum Bl.—Marei Parei spur (Cl. 11072), Kamborangah (H. 25740).

A species of uncertain systematic position; it shows affinities to *Grammitis*.

P. alternidens Cesati—s.l. (Burbidge), Kamborangah (Gibbs 4229), Pakka to Lobang (Cl. 10721).

I suspect that some or all of the above specimens belong to *P. Hieronymusii*, a species unknown to me when I examined them. The genuine *P. alternidens* from Sarawak is a small species of thinner texture, the leaves 3–4 cm. long by 1 to 1.5 mm. wide, the minute, entire, tooth-like lobes very ascending.

P. bryophyllum v.A.v.R. Bull. Jard. bot. Buitenz. II. ser. XVI: 35. 1914 Handb. Suppl. 366.—Lumu Lumu to Kamborangah, on mossy tree trunks (H. 25467).

New to Borneo; known previously only from Penang (Matthew 499, 924). This species is very like *P. alternidens*, but a little larger, and densely glandular-pubescent with short glistening articulated hairs.

P. papillatum v.A.v.R. l.c. pl. 7. Handb. Suppl. 367.—Marei Parei ridge, on mossy trees (H. 25604, *forma minor*).

New to Borneo. A much smaller form than the type from G. Sago, Sumatra (Matthew 693), the leaves 7–8 cm. long by 5–7 mm. wide only, but I cannot find any other essential difference. It agrees with *P. bryophyllum* in pubescence, but it is nearly fully pinnate, the pinnæ with 1 or 2 small lobes above in addition to one lobe below.

P. minutum Bl., C. Chr. Gard. Bull. S.S. 4: 402.—*P. cucullatum* part, Gepp 203.—Gurulau spur (Gibbs 4018). Also on Mt. Tibang (Mjöberg).

This differs from the two preceding species in the midrib, margins and sori being clothed with long very thin hairs; the segments each bear a basal sorus, and often also one near the tip.

P. Hieronymusii C. Chr. Index.—Kamborangah to Pakka, on bases of tree trunks and on rocks (Tp. 1659 part, H. 25476, Cl. 27989), Tenompok (Cl., s.n.).

New to Borneo, but probably confounded with *P. alternidens*, q.v. *P. Hieronymusii* differs from *P. alternidens* by its rigidly coriaceous texture, much longer (up to 10 cm.) leaves with patent or somewhat oblique segments which are often furnished with an upper basal tooth.

P. cornigerum and *P. alternidens* Ridley, Journ. Mal. Br. R. Asiatic Soc. 4; 82–83, belong here, at least specimens from Pahang (nos. 20734, 23307) and Johore (10680) received from Holttum under these names. The type came from Malacca (Cuming 380 ! at Berlin).

P. denticulatum (Bl.) Presl.—Gurulau spur (Cl. 10855), near Tenompok, on mossy tree trunk, rare (H. 25731), Dallas-Tenompok ridge (Cl. 28157).

CTENOPTERIS (Blume, Kunze, Bot. Zeit. 1846: 425).

Under this name I unite a considerable number of Malayan-Polynesian (and other tropical) species which are of medium size, pinnatifid or subpinnate with free veins, of firm to coriaceous texture, the leaves tufted on a short rhizome, the scales of which are entire, rarely ciliate, the sori superficial or slightly impressed, rarely deeply immersed, the sporangia naked. The group is certainly a natural one, but it should perhaps be widened to include *Cryptosorus*, as it must be admitted that no clear boundary exists between the two groups.

P. Moultoni Copel. Phil. Journ. Sci. 10C: 149. 1915.—*P. blechnoides* Baker 1894: 253, Copel. Keys 197.—*P. revolvens* v.A.v.R. Bull. Jard. bot. Buit. III ser. 2: 170, 1920.—*P. pseudorevolvens* v.A.v.R. l.c. 5: 219. 1922.—s.l. (Haviland 1487), above Kamborangah (Cl., s.n.).

To this species I refer all specimens from the Malayan region and Ceylon which have been named either *P. decorum* Brack. or *P. blechnoides* (Grev.) Hk. They resemble closely the former, the type of which came from Tahiti, in size and general habit, but differ in some minute characters; the sori are slightly impressed, not deeply immersed, and the peculiar hairs are different. The hairs are confined to the under side of the black midrib and the margins of young leaves, and are short and soft, light brown and variously branched, the basal portion and branches of

the same structure. The hairs of the genuine *P. decorum* consist of an appressed basal, whitish, opaque, membranous portion which bears on the upper side 1–4 erect, subulate, rigid, castaneous and glossy setæ. The original *P. blechnoides* from Tonga is, I believe, the same as *P. decorum* and not identical with *P. contiguum* and *Cryptosorus Seemanni* J. Sm. as stated by Hooker. *P. Moultoni* is apparently a common fern in Borneo, the Malay Peninsula, and the adjacent islands; it is the only common small *Polypodium* in the lowland forest, occurring frequently in old mangrove as well as inland forest and also on the mountains. It is not common on Kinabalu, and probably occurs on the lower slopes. (C. Chr.).

I have seen the types of both *P. revolvens* and *P. pseudorevolvens*. The differences between them are in my opinion not significant, and fall well within the range of variation of this common species. (R.E.H.).

P. mollicomum Nees & Bl.—*P. minutum* Baker 1879: 42.—*P. malaccanum* Baker? Gepp 203, Copel. Keys 396.—s.l. (Burbidge), Pakka (Gibbs 4251, Tp. 1714), Marei Parei spur (Cl. 11049), Lumu Lumu to Kamborangah (H. 25461, Cl. 27994, 28969, 28967), above Pakka? (Cl. 27756).

Basal scales castaneous, narrowly linear-lanceolate, furnished with a few long and very thin deciduous hairs and with a tuft of 3–5 similar hairs at the apex, the frond more or less densely pubescent with rufous hairs, the pinnules linear-oblong, not much widened at the base. The specimens referred here look rather different, and belong perhaps to two species; they vary especially in the density of the pubescence and in the size and shape of the pinnæ. Those with broader pinnæ and longer fewer hairs are like *P. brevivenosum* v.A.v.R., but are much bigger than the type of that species; it is very probable that the type in question is a young plant, immature as to size but already fertile.

P. subminutum v. A. v. R. Handbook 598.—*P. minutum* Syn. Fil. 328 p.p.—*P. repandulum* forma *pilosa* v.A.v.R. Bull. Jard. bot. Buitenz. II ser. XVI: 36. 1914.—Lobang (Tp. 1768, H. 25550), Tenompok to Lumu Lumu, on mossy tree trunks (H. 25431).

This species was described from two very small plants collected in Java by Forbes. Subsequently the author considered it to be only a form of *P. repandulum*, and as such referred to it a number of specimens, chiefly from Sumatra, most of which I have been able to examine. *P. repandulum* however is so distinct in having rather sparse *branched* hairs, and also in its more distant, more oblique and more coriaceous pinnæ, that in my opinion the

"forma pilosa" should be regarded as a separate species. Amended diagnosis is as follows:

P. subfalcato Bl. affinis, differt: pinnis repandis vel crenatis, non dentatis, subtus sat dense breve pilosis.

A typical collection is: Sumatra, G. Kœrintji, Bünnemeijer 9311; duplicates of this have been distributed to a number of herbaria.

The fronds are tufted, usually about 15–20 cm. long by 2.5 cm. wide, the pinnæ separated by about twice their own width, 1.5 to 2.5 mm. wide, almost at right angles to the rachis or somewhat oblique, tapered to a narrow rounded apex, dilated towards the base and broadly adnate to the rachis and decurrent below, their edges more or less repand or crenate, texture thin and somewhat translucent; the lower pinnæ gradually reduced and extending to the base of the stipe; the stipe and rachis above and beneath copiously rather shortly hairy, the hairs very slender, pale brown, simple, not branched at the base, similar shorter hairs more or less densely distributed over the lower surface of the pinnæ; sori terminal on veins, which reach 2/3 distance towards the margin and terminate in hydathodes on the upper surface. There is some variation in the denseness of the pubescence of the pinnæ. (R.E.H.).

I have seen specimens from Ceylon, Sumatra, Java, the Malay Peninsula and Borneo. In Sumatra the species is very common on mossy trees in mountain forests at about 6000–8000 feet altitude, and sometimes has fronds as much as 32 cm. long. *P. subfalcatum* Bl. is rather similar, but quite distinct in its more sparse but longer hairs and distinctly dentate pinnæ. Of the Kinabalu plants Copeland referred Topping 1768 to *P. subfalcatum*. H. 25550 has on some plants unusually broad fronds, up to 3.5 cm. in width.

P. nutans Bl.—Pakka to Lobang (Tp. 1732, det. Copeland), Pakka (Cl. 28978).

This species approaches the following group by its short creeping rhizome which is covered with dark brown ciliate scales, but the hairs on the scales are softer and the sori are not immersed. The frond is hairy on the rather long stipe and the midrib beneath only, the hairs blackish-brown, very short and usually clustered 2–5 together.

Cryptosorus (Fée).

Pectinately divided species with short creeping rhizome which is clothed with subclathrate, black-brown and spinescent-ciliate scales, the sori remote from the margin and sunk in deep cavities which are usually fringed with hairs. A fairly natural group, but not very sharply distinct

from *Ctenopteris* on the one hand and *Prosaptia* on the other.

P. venulosum Bl.—On the ridge above Kamborangah (H. 25524 bis), Dachang (Cl. 28441). New to Borneo.

P. obliquatum Bl.—Copel. Keys 396.—Recorded by Copeland; no specimen seen.

P. celebicum Bl.—Marei Parei spur (Cl. 11050), Kamborangah, pendulous from trees near river (H. 25524), falls above Lumu (Cl. 29912), Silau basin, on rocks by stream (Cl. 29044).

Very near *P. obliquatum*, differing chiefly by the less oblique sori and by the edges of the cavity not being raised but densely fringed.

P. khasyanum Hook.—Silau basin at 7000 ft. (Cl. 29029).

Differs from *P. Burbidgei* in the rachis being hardly winged, and the sori only on the distal parts of the lobes.

Prosaptia (Presl).

This group has recently been restored to generic rank by Copeland and others; to this I should agree if I could see how *Prosaptia* may be distinguished from *Cryptosorus*, and retaining the latter in *Polypodium* involves the retention also of *Prosaptia*. The species of both groups are quite similar in habit, texture, pubescence and in the structure of the scales, but in *Prosaptia* the deeply immersed sori are marginal and often protruding beyond the margin, which is the only reliable difference between the two groups.

P. Emersoni (Hook. & Grev.) C. Chr. comb. nov.—*Davallia Emersoni* Hook. & Grev. Ic. Fil. pl. 105.—*D. alata* Bl., C. Chr. Index (not *Polypodium alatum* L.), *Prosaptia alata* Christ, Copel. Keys 407.—*Polypodium serraeforme* (Wall.) J. Sm. 1841 (nom. nud.) v.A.v.R. Handb. 615.—Below Dallas, on tree by stream (H. 25366).

P. contiguum (Forst.) J. Sm.—*Davallia contigua* Spr., C. Chr. Index, Baker 1879: 39, 1894: 251, Gepp. 199.—*Prosaptia contigua* Pr., Copel. Keys 407.—s.l. (Burbidge, Haviland 1484), below Kamborangah (Gibbs 4138, Tp. 1640), Lumu Lumu (H., s.n.), Tenompok (Cl. 28681, 26981), Dachang (Cl. 28317).

P. davalliaceum Baker. *Prosaptia* Copel. Univ. Cal. Publ. Bot. 12: 404. 1931.—*Polypodium monocarpum* Rosenst. Fedde Repert. 12: 178. 1913.—*Prosaptia linearis* Copel. Phil. Journ. Sci. 4C: 115. 1909 (not *Polypodium lineare* Thb.); Keys 407.—*Polypodium acrosoroides* v.A.v.R. Bull. Jard. bot. Buitenz. II ser. XI: 21. 1913; Handb. Suppl. 371.—*Davallia contigua* var. *monosora* Gepp 199?—Below Pakka (Gibbs 4275?, Tp. 1715, H. 25506), above Kamborangah, on rocks and trees (Cl. 27993).

Copeland was quite right in identifying Rosenstock's species with Baker's; I have co-types of both, from New Guinea. The Kinabalu form matches exactly the type from New Guinea, and is somewhat larger than *Prosaptia linearis* Copel. from Luzon, which is otherwise quite the same.

Group of P. grammitidis.

An isolated group of few known species which in cutting and size resemble some species of *Cryptosorus* and *Prosaptia* but in all important characters are quite different. The short creeping rhizome is covered with brown, entire and rather soft scales, the leaves grass or light green, papyraceous to subcoriaceous, glabrous, pectinato-pinnatifid, narrowed (often suddenly) below into a wavy or crenate wing to the stipe, the veins indistinct, usually forked, the sori superficial or slightly impressed. The type-species is *P. grammitidis* R. Br. from Australia and New Zealand, and I only know one Malayan species belonging to the group.

P. Curtisii Baker.—*P. decrescens* Christ, Copel. Phil. Journ. Sci. 1 Suppl. II pl. 17 (reduced).—Tenompok to Lumu Lumu (H. 25432, Cl. 27965) Kamborangah (Cl. 28966).

New to Borneo; known previously from Sumatra (Padang, Curtis; G. Sago, Matthew), Celebes (Kjellberg 3534), Philippines and New Guinea (Arfak Mts., Gibbs 5654). The Kinabalu specimen is quite typical, medium-sized (leaves 25 by 5 cm.), abruptly narrowed into a wavy wing to the stipe. The species grows much larger; Matthew collected specimens with leaves 40–50 by 13 cm.

Themelium Moore.

(Group of *P. millefolium* Bl.).

This group of several Malayan-Polynesian species is so different from all other groups of free-veined Polypodia that it is natural to segregate it as a subgenus or even as a genus.

P. taxodioides Baker 1879: 42.—*P. pulcherrimum* Copel., Elmer Leaflets 3: 841. 1910.—s.l. (Burbidge, type), Marei Parei Spur (Cl. 11040).—Sarawak: Mt. Murud (Mjöberg).—Mindanao (Elmer 11355, Herb. Copel.). Celebes (Kjellberg 1447).—New Guinea (Keysser).

P. millefolium Bl.—Marei Parei spur (Cl. 11058).

P. halconense Copel. Phil. Journ. Sci. 2C: 138, t. 2. 1907.—Falls above Lumu (Cl. 30447).

Thylacopteris (Kunze, J. Smith).

P. papillosum Bl.—Kiau to Lobang (Tp. 1588), Dallas, on rock by stream (H. 25143, Cl. 26488, 26892, 27290), Tenompok (Cl. 29572).

This (the only species of its group?) resembles *P. vulgare* more nearly than does any other Malayan "Eupolypodium", and in my opinion both species are much more closely related to *Goniophlebium* than to any group of free-veined species. I find no character, the free veins excepted, by which it differs from several Malayan species of *Goniophlebium* § *Schellolepis* with immersed sori. It stands to such species exactly as *P. vulgare* stands to the Asiatic species of *Goniophlebium* with superficial sori.*

Group of P. coloratum.

A small group of three described Bornean species of doubtful systematic position. Copeland placed them in *Goniophlebium*, but I am by no means convinced that this is right. The venation is much less regular; the veins form irregular areoles which are not always closed. I hope to return to these species later, but will here remark that I find more common features (scales, colour, texture and venation) between them and the group of *P. taeniatum*.

P. brachypodium Copel. 1917: 62.—Gurulau spur (Tp. 1620, 1823), Lobang (Cl. 10354), Kiau (Cl. 10225), Tenompok (Cl. 28344).

This species is hardly different from *P. coloratum* Copel..

Goniophlebium § *Schellolepis* J. Smith.

P. integriore Copel. Phil. Journ. Sci. 2C: 139. 1907.—Tenompok (Cl., s.n.).

This agrees with the description except that the pinnæ are not linear but narrowly elliptico-lanceolate, 10 by 1.5 cm. I have the same from Sarawak (Mt. Penrissen, Mjöberg).

var. **rajaense** C. Chr.—*P. rajaense* C. Chr. Mitt. Inst. allg. Bot. Hamburg 7: 159. 1928.—Tenompok, climbing on trees and creeping on ground in forest (H. 25393, Cl. 29484, 26855).

Differs from the type in the pinnæ being twice as broad, and in having five pairs of pinnæ.

P. subauriculatum Bl.—Near Kiau, in secondary forest by stream (Cl. 10006, H. 25594), near Lobang, open place in forest (H. 25547), Dallas-Tenompok ridge, summit (Cl. 27431), Menetendok gorge (Cl. 29625).

P. pallens Bl., v.A.v.R. Handb. 620.—Tenompok, on tree (H. 25416), top of Menetendok Gorge, clambering over ground (Cl. 29627).

* See my paper: On the systematic position of Polypodium vulgare. Dansk. Bot. Arkiv 5 no. 22. 1928.

New to Borneo. This resembles a small frond of *P. subauriculatum,* to which *P. pallens* was referred as a variety in my Index. It differs by the whole leaf being densely villous with short and crisped, articulate, whitish hairs. It is possible that *P. pallens* represents a young stage of *P. subauriculatum;* young plants of *P. verrucosum* are similarly though less densely hairy, and are often prematurely fertile. The present specimens have about 20 pairs of pinnæ, which are 8 cm. long, 8 mm. wide, sessile and articulated to the rachis, unevenly crenate, the sori deeply immersed with papillæ on the upper side. By the last character it differs from *P. molliculum* Copel., which may be a form of the same species.

P. verrucosum Wall.—Dallas-Tenompok ridge (Cl. 27350). This agrees exactly with typical specimens from the Malay Peninsula. The pinnæ are long-stalked.

SERIES II SPECIES WITH MORE OR LESS IRREGULARLY NETTED VEINS (The subgenera Pleopeltis, Selliguea and Myrmecophila pt. of Index Filicum).

Copeland unites most of the many groups falling under this series in a single genus, *Microsorium,* which however includes such widely different species that his treatment does not seem to me an improvement. In my opinion, his genus can be divided into several natural groups (subgenera or genera), but, because of the relatively few species dealt with below, this paper is not the right place to give my reasons for this opinion, which must be supported by reference to a considerable number of species; I confine myself therefore to placing in parenthesis the name of the group to which each species belongs.

P. (Crypsinus) **kamboranganum** C. Chr. n. sp.—Species dimorpha, *P. costulato* Baker et *P. Wrayi* Baker affinis, a priore differt foliis sterilibus ellipticis, basi longe decurrentibus, soris rotundis, a posteriore paleis rhizomatis integerrimis, venis lateralibus distinctis.

KINABALU: Kamborangah, epiphyte in ridge forest (H. 25543, type in Herb. C. Chr.).

Rhizome creeping, densely clothed with reddish-brown, lanceolate, long-acuminate and quite entire scales. Sterile leaves 12–13 cm. long including the stipe (3 cm.), 2 cm. wide in the middle, subacute at the apex and long cuneately decurrent at the base, glabrous, chartaceous, the margins with shallow notches between each two distinct main veins. Fertile leaves up to 20 cm. long including the stipe (5 cm.), 5–8 mm. wide, linear and decurrent. Sori superficial, round, uniseriate, not confluent but reaching both costa and margin when mature.

I cannot identify this form with any of the many Malayan species of this group. Its nearest ally is the Sumatran *P. costulatum* Baker (not *Acrostichum costulatum* Cesati) which differs in its ovate, not decurrent sterile leaves and oblong or linear, often confluent sori. In general habit our species more nearly resembles a broad form of the Peninsular *P. Wrayi*,* which has finely ciliate scales and invisible main veins.

P. (?) **tæniophyllum** Copel. Phil.. Journ. Sci. 7C: 65. 1912.—Dallas (Cl., s.n., sterile).

P. (Crypsinus?) **accedens** Bl.—s.l. (Tp. 1812), Tenompok (Cl. 26704, 26851, 28199), Kabayau (H., s.n.).

P. (Crypsinus?) **stenopteris** Bak. 1879: 43.—*P. soridens* Bak. 1894. 253.—s.l. (Burbidge, type; Haviland 1493, Haslam), above Kamborangah (Gibbs 4225), Pakka to Lobang (Tp. 1734, Cl. 10716), Lumu Lumu to Kamborangah (H. 25453, Cl. 27063, 27961), Silau basin (Cl. 29277).

P. (Crypsinus?) **stenophyllum** Bl.—s.l. (Haviland 1489).

The systematic position of the last four species is still uncertain to me.

P. (Pleuridium) **rupestre** Bl.—Tenompok to Lumu Lumu (H. 25441, Cl. 27423), Silau basin at 7000 ft. Cl. 29030, 29705).

P. (Pleuridium) **sarawakense** Baker—*P. peltatum* v.A.v.R. Handb. 632.—*Pleopeltis peltata* Scort., Ridley Journ. Mal. Br. R. Asiatic Soc. 4: 91.—Kiau (Tp. 1574, Cl. 10240), near Dallas, on fallen tree by stream (H. 25148, Cl. 27349), Dallas-Tenompok trail (Cl. 26942, 29582).

Common in Sarawak, and now also recorded for Sumatra (Hancock 79) and the Peninsula.

P. (Pleuridium) **Zippelii** Bl.—Near Menetendok, on rocks by stream (H. 25297, 25589), Tenompok, epiphytic (Cl. 29231, 26929).

P. (Pleuridium) **albidopaleatum** Copel. 1917: 63.—Pakka to Lobang (Tp. 1748), Marei Parei ridge (Cl. 11060), Lumu Lumu to Kamborangah, on mossy tree trunk (H. 25452, Cl. 28387).

P. triquetrum Gepp p. 204 (Gibbs 4155) is probably this species.

* *P. Wrayi* has hitherto not been found in Borneo, though it is included in Copeland's Keys (p. 401); the species from Sarawak formerly referred to it has recently been described as a new species, *P. Clemensiae* Copel. Brittonia 1: 76, pl. 2. 1931. This chiefly differs from *P. Wrayi* by its less dimorphous fronds and biseriate sori; it is however not a new species but identical with *P. subsparsum* Baker from Sumatra (Beccari, Herb. Inst. bot. Firenze no. 12593), and *P. Beccarii* v.A.v.R. Handb. 633 is a synonym (based on the same collection?).

P. (Pleuridium) **platyphyllum** Sw.—Tenompok, epiphyte (Cl. 29545).

P. (Microsorium) **heterocarpum** Bl.—*P. Zollingerianum* Kunze, C. Chr. Index.—*Nephrodium pteropodum* Bak., *Aspidium pteropodum* Diels, C. Chr. Index, *Tectaria pteropoda* Copel. Keys 368.—*Polypodium Scortechinii* Baker.—Tenompok, on rocks and trees (H. 25720), near Kabayau, on rocks and trees by stream (H. 25628), Dallas, east ravine (Cl. 27305), Dallas-Tenompok ridge (Cl. 26800).

H. 25628 is a very large form with the lamina 10 cm. wide, ovate, suddenly narrowed into a long wing.

P. (Leptoselliguea) **fluviatile** Lauterb., Engler's Bot. Jahrb. 44: 507. 1907.—s.l. (Tp. 1491). Bettotan, near Sandakan (Boden Kloss 18733).

Extremely dimorphous, the long fertile leaves sometimes not more than 2–3 mm. wide; the sterile ones are hardly different from those of *P. selliguea* Mett.

P. (Leptoselliguea) **interruptum** C. Chr.—Lobang (Cl. 10357), near Tenompok, on rocks by stream (H. 25300, Cl. 29312), falls above Lumu (Cl. 29968).

The Kinabalu form is not quite identical with the type from Sarawak (Hose 238, *Gymnogramme acuminata* Bak.), but it cannot be separated specifically. The leaves are longer decurrent and the sori larger and shorter, mostly round. Both forms may be varieties of *P. macrophyllum* (Bl.) Reinw., which seems to be a very variable species and to which, when taken in a wide sense, most of the thin-leaved Selligueas might very naturally be referred. A very peculiar form has been collected by the Clemens expedition at Menetendok (Cl. 29624); some fertile leaves are broad, with linear or interrupted sori, while some are only 1.5 cm. wide (the lamina over 30 cm. long) with a single row of large irregular roundish sori on either side of the midrib.

P. (Leptoselliguea) **polysorum** Brause, Engler's Jahrb. 56: 203. 1920.—Tenompok (Cl. 26184, 28642). Type from Papua; new to Borneo.

This species, allied to *P. macrophyllum*, is marked by the subsessile, long-decurrent, oblanceolate, isomorphous fronds and the very broad sori which when mature are almost contiguous and run at an angle of 40–45° from the midrib to the margin, sometimes protruding beyond the latter; sori are borne throughout the length of the fertile fronds, from the tip down to the wing-like lower portion of the blade. The climbing rhizome is densely covered with fuscous brown, very thin (not clathrate as described by Brause), broad and long-acuminate, obscurely dentate scales.

Under the name **Leptoselliguea** sect. nov. I unite a number of Malayan species which were previously referred to *Selliguea*. The latter name I use, however, only for the coriaceous species (*P. Féei*, *P. Mettenianum*, etc.), which are derivatives of *Pleuridium*, while *Leptoselliguea* is a group of species of herbaceous texture and dark green colour which agree with *P. heterocarpum* and related species in almost all characters, differing by the uniseriate, often confluent and linear (selligueoid) but sometimes round (polypodioid), sori; both kinds of sori may be found in the same species. The pinnatifid species of *Selliguea* look rather different from both groups, but some South-Chinese species seem to connect them with the simple-leaved species of *Leptoselliguea*. The type-species of this section is *P. macrophyllum* (Bl.) Reinw.

P. (Phymatodes) **insigne** Bl.—Below Dallas, on wet rocks by waterfall (H. 25274, Cl. 27291). New to Borneo.

P. (Phymatodes) **commutatum** Bl.—Kiau (Cl. 10008), near Menetendok, on rocks by river (H. 25572, Cl. 29582).

P. (Phymatopsis) **ithycarpum** Copel. 1917: 64.—Kiau (Tp. 1578), Lobang (Tp. 1778), near Menetendok, on trees by river, abundant (H. 25568), Dallas, east ravine (Cl. 27294, 27025), Tenompok (Cl. 28387).

A very large fern, probably over 1 m. high. Rhizome 1 cm. thick, wide-creeping, the scales broadly ovate or roundish, thin, dark brown; stipe 40 cm. long, 1 cm. thick; pinnæ several pairs, 30–35 cm. long, 3.5–4.5 cm. wide, connected by a wing 1 cm. broad. It is with doubt that I maintain this species, as I do not see clearly how it may be distinguished from *P. longissimum* Bl.

P. (Phymatopsis) **tæniatum** Sw.—*P. palmatum* auctt., C. Chr. Index.

This species comprises in my opinion an intricate complex of forms, several of which have been treated as species by some writers; a comparison of a great number of specimens has shown it impossible to regard these forms as good species, as apparently all possible intermediates between the extreme forms occur; Sumatra and Borneo are especially rich in such forms. I cannot here give a complete review of all the many forms, but mention briefly a few of the Bornean ones.

forma typica.—*P. angustatum* Bl. Fl. Jav. pl. 62.—Fully pinnate with nearly all pinnæ distinctly narrowed toward their base, the leaves somewhat dimorphous, the fertile ones with narrower pinnæ, often under 1 cm. wide, the sterile pinnæ lanceolate, 1.5–2 cm. wide. The type specimen in Herb. Thunberg (Upsala) matches Blume's excellent plate quoted above. *Pleopeltis subtaeniata* v.A.v.R. Handb. Suppl. 402 is very nearly the

same. Kinabalu specimens are: Kamborangah (H. 25721), falls above Lumu, on rocks (Cl. 29971), Tenompok (Cl. 28245), above Pakka (Cl. 27757).

var. palmata (Bl.) C. Chr.—*P. palmatum* Bl. Fl. Jav. pl. 64.—*P. laciniatum* Baker 1894: 253, *P. macrochasmum* Copel. Keys 404.—*P. ebenipes* Baker 1879: 43, Copel. Keys 404.—*P. Moseleyi* Baker.—*P. quinquefidum* Baker.—*Pleopeltis taenitidis* v.A.v.R. Handb. Suppl. 402.—Fertile and sterile leaves similar, pinnate below only or deeply pinnatifid throughout, the pinnæ sessile with a much widened base or confluent by a wing to the rachis, sometimes 2.5 cm. wide. Kinabalu specimens: s.l. (Haviland 1490, Haslam), Marei Parei ridge (Cl. 11066).

P. crenulatum Mett. (*Pleopeltis taenifrons* v.A.v.R. Handb. Suppl. 402, 527) is scarcely different from var. *palmata;* it is a form with the fronds simple or at best with 1–3 pinnæ.

var. borneense (Christ) C. Chr. *P. Griffithianum* v. *borneense* Chr. Ann. Jard. Bot. Buitenz. 20: 122, Copel. Keys 402.—Fronds simple, the lamina up to 25 cm. long, 5 cm. wide, the fertile ones a little narrower and longest; or fronds pinnate with 1 or 2 pairs of lateral pinnæ, in which case they are distinctly dimorphous, the fertile intermediate between *f. typica* and var. *palmata,* fully pinnate with the pinnæ adnate to the rachis but not widened, about 1.5 cm. wide, the sterile having pinnæ 3–5 cm. wide. This form has, of course, nothing to do with the Himalayan-Chinese *P. Griffithianum* Hk. No specimens of this have been found on Kinabalu, but other Bornean specimens are: Dutch Borneo (Hallier 684, 3286), Sarawak (Mt. Dulit and Mt. Penrissen, Mjöberg; Bongo Range, Brooks & Hewitt 9).

I may add that in my opinion the characters by which v.A.v.R. distinguished his five species (the rhizome cretaceous or not, the scales entire or obscurely dentate, and the venation) do not hold good. I have referred to all the above varieties specimens varying as to these characters.

P. (Phymatopsis) **pakkænse** C. Chr. n. sp.—Rhizomate ad arbores repente, non cretaceo, paleis peltatis, imbricatis, rufidulis, e basi ovata longe acuminatis, integris dense obtecto. Stipite rigido, nitente, ad 25 cm. longo. Lamina chartacea, glaberrima, late et breviter ovata, vix 25 cm. longa, ca 30 cm. lata, basi in stipitem breve decurrente, ad alam 2–4 mm. latam profunde pinnatisecta. Segmentis præter terminalem cum supremis lateralibus confluentem 5–6, late lanceolatis, 15–17 cm. longis, medio 4 cm. latis, sinubus rotundatis separatis,

acuminatis, marginibus incrassatis, leviter serrulatis; venis secundariis subtus prominentibus, usque ad marginem extensis, 3–5 mm. inter se remotis, minoribus subscalpturatis, areolas inter secundarias 3–seriatas, liberas includentes formantibus. Soris utrinque uniseriatis, a costa 3–4 mm. remotis, superficialibus, globosis, 4 mm. diametro, paraphysibus nullis.

KINABALU: Pakka, on mossy tree near stream (H. 25515, type in Herb. C. Chr.), on rocks above Kamborangah (Cl. 27962), Silau basin at 7000 ft. (Cl. 28857).

Described from a single fertile leaf, which shows several of the characters of *P. taeniatum* but is quite different in several respects: the more rigid texture and prominent veins, the segments really serrulate, but very shallowly, not barely obscurely crenate with small notches as in all forms of *P. taeniatum*. Some much smaller leaves, with segments 8 cm. long by 1 cm. wide (fertile), were also taken by Holttum in the same collection; the description therefore applies to leaves of a well-grown plant.

P. (Phymatopsis) **incurvatum** Bl.—Kamborangah to Pakka, common (Gibbs 3110), Gurulau spur (Tp. 1622, 1743), Tenompok, on ground, edge of forest (H. 25418), Dallas-Tenompok ridge (Cl. 27564), Lumu Lumu to Kamborangah, among rocks (Cl. 27933).

P. (Phymatopsis) **albidosquamatum** Bl.—Tenompok, on tall tree (H. 25293, Cl. 27904), Dallas-Tenompok ridge (Cl. 28153).

P. (Myrmecophila) **sinuosum** Wall.—Kota Belud to Kabayau (Cl. 9791).

P. (Drynariopsis) **heracleum** Kunze.—Lobang to Kiau (Tp. 1805), Menetendok, on rocks by river (H. 25593, Cl. 29668).

PYCNOLOMA C. CHR. Dansk Bot. Arkiv 6, no. 3 p. 75. 1929.

P. murudense C. Chr. l.c. 78, pl. 8.—*Polypodium costulatum* Baker 1894: 254, Copel. Keys 402.—Dahombang river (Haviland 1474), Tenompok (Cl. 28983). Collections from Sarawak are: Mt. Murud (Mjöberg), Mt. Dulit (Hose 310).

LOXOGRAMME PRESL.

L. parallela Copel.—Pakka (Tp. 1717, H. 25504), trail to Kamborangah, on tree (Cl. 28986).

L. ensifrons v.A.v.R. Bull. Jard. bot. Buitenz. II ser. XI: 16, pl. 4. 1913.—Kiau (Cl. 10239), Dallas-Tenompok, a common epiphyte (H. 25291), Tenompok (Cl. 26933, 29229), Dallas, east ravine (Cl. 27307).

In his Keys (p. 408) Copeland quotes *L. ensifrons* as a synonym of *L. iridifolia* (Chr.) Copel. (*Polypodium*

iridifolium Diels, C. Chr. Index), but in my opinion he has misunderstood the synonymy of these species. The plant from Celebes described and illustrated by Christ is the same, or very nearly the same, as *L. antrophyoides* (Bak.) C. Chr. Mitt. Inst. allg. Bot. Hamburg 7: 163. 1928 (*Leptochilus antrophyoides* C. Chr. Index) from Mt. Matang, Sarawak (Hose 162!). I distinguish the two allied species thus:—

L. antrophyoides. Fully dimorphous. Sterile leaves oblanceolate, acute, about 2 cm. wide above the middle, narrowing gradually toward the base, at best 1 cm. wide at the very base; fertile leaves narrowly linear, 3–6 mm. wide from base to apex, much longer than the sterile.

L. dimorpha Copel. is perhaps a form of this with leaves still narrower (2 mm. wide).

L. ensifrons. Subdimorphous. Sterile leaves very like those of the former species, suboblanceolate, 3–5 cm. wide above the middle, 2–3 cm. wide at the very base, the midrib flat and very thick beneath (4–5 mm. wide near base), prominent and angular above. Fertile fronds considerably longer, like the sterile ones in the lower half but usually prolonged into a long attenuated fertile apex, which is about 1.5 cm. wide near the basal sori. The specimens from Kinabalu agree excellently with the type from Labang (Amdjah 267!).

L. involuta Pr. var. **gigas** Copel. Phil. Journ. Sci. 3C: 35. 1908.—Tenompok (H. 25356 bis).

This specimen was placed in the same collection as *L. nidiformis;* in shape and appearance in the field the two are closely similar, and in collecting they were not distinguished. The specimen agrees with Copeland's brief description. The costa is prominent beneath, and the fronds up to 75 cm. long. In texture the frond is more coriaceous than *L. nidiformis* (*see* below), the veins not quite so distinct, and the areolæ considerably smaller. (R.E.H.).

A specimen from Sarawak (Nat. Coll. Bur. Sci. 1553), named by Copeland *L. involuta* var. *gigas*, is to me a form of *L. avenia* Pr., and different from the Philippine variety represented by Copeland's Pterid. Philip. exsic. no. 87. (C. Chr.).

L. avenia (Bl.) Pr.—*Gymnogramme* Baker 1879: 43.—*Loxogramme Blumeana* Pr. Copel. Keys 408.—Koung (Burbidge), Kiau to Lobang (Tp. 1609).

L. nidiformis C. Chr. n. sp.—Species maxima foliis isomorphis, oblanceolatis, 60 cm. vel ultra longis, ad 12 cm. supra medium latis, sessilibus, versus basin gradatim angustatis, apice breve acutis, tenuiter papyraceis,

costa superne prominente, angulata, inferne complanata, parte inferiore 7 mm. lata; venis sat distinctis, areolis venulas liberas sæpius includentibus. Soris in parte tertia superiori laminæ, angustis, sub angulo 45° oblique e costa currentibus, ca 1 cm., inter se remotis, nec costam nec marginem attingentibus.

KINABALU: Tenompok, epiphyte, frequent (H. 25356, type in Herb. C. Chr.; Cl. 26949), Dallas, on tree by stream (Cl. 27300, 26489), Dallas-Tenompok ridge (Cl. 27037).

This is the largest form of the genus known to me; in size and shape it resembles smaller leaves of *Asplenium nidus*, whence the name. It is not *L. involuta* var. *gigas* Copel., the costa of which is prominent beneath and flat above, but it is related to *L. avenia* Pr., which is much smaller with closer sori.

HYMENOLEPIS KAULFUSS.

H. revoluta Bl.—Tenompok (Cl. 27794).

H. revoluta Bl. var. **planiuscula** (Mett.) Hieron., C. Chr. Dansk Bot. Arkiv 6 no. 3: 58. 1929.—Kiau to Lobang (Cl. 10224, 10396), Dallas-Tenompok (H. 25292, Cl. 26975, 28191), Dallas (Cl. 27503), Kundasan, on tree at 30 m. above ground (Cl. 29106).

H. squamata Hieron. var. **borneensis** C. Chr. l.c. 60.—Pakka to Low's Peak (Cl. 10664, Tp. 1675, 1703), on ground in a thicket of bushes at 11000 ft. (H. 25487, Cl. 27048), above Lumu (Cl. 27955).

CYCLOPHORUS DESVAUX.

C. adnascens (Sw.) Desv., Gepp p. 204.—Gurulau spur (Gibbs 3995, not seen), Dallas (Cl. 29229).

C. varius (Klf.) Gaud.—Koung, on rocky bank among trees (H. 25123), Menetendok, on tree (Cl. 29628), Dallas (Cl. 29299; 27293?, sterile), Tenompok (Cl. 28685).

C. Christii (Gies.) C. Chr.—Dallas (H., s.n., sterile).—Near Sandakan (Boden Kloss 19052).

C. flocciger (Bl.) Pr.—Tenompok (H. 25358), Dallas-Tenompok trail (Cl. 27327).

Rhizome stout, the scales subulate from a nearly black base, stipes short and rather thick, the leaf with much recurved margins, tomentum very loose and woolly, the midrib beneath thick and pale, areolæ fairly regular with about three sori in each; fronds uniform. Exactly similar specimens have been collected in the Malay Peninsula on the Main Range at about 4000 ft. altitude (*e.g.* Henderson 21697).

C. borneensis Copel. 1917: 64.—Kiau (Tp. 1503), Tenompok (Cl. 27479, 26984).

Differs from *C. flocciger* in the following points: rhizome slender, the scales shorter, lanceolate, stipes longer and more slender, leaf drying nearly flat, the margins hardly recurved, the tomentum (of two kinds of hairs as in *C. flocciger*) closely pressed, the midrib beneath slender, sometimes blackish, areolæ rather irregular, narrow, each containing numerous close sori; fronds usually rather dimorphous, sterile to about 12 by 2 cm., fertile 15 by 1 cm. Cl. 26984 has some fronds repeatedly dichotomously branched at the apex.

DRYMOGLOSSUM Presl.

D. piloselloides (L.) Pr., C. Chr. Dansk. Bot. Arkiv 6 no. 3: 86. 1929.—Dallas, on forest trees (Cl. 27296).

DIPTERIS Reinwardt.

D. conjugata Reinw.—Below Pakka (H., s.n.). A much dwarfed form, growing in a very exposed place on the ridge.

CHEIROPLEURIA Presl.

C. bicuspis (Bl.) Pr.—s.l. (Burbidge), Gurulau spur (Gibbs 3998), Lumu Lumu to Kamborangah (Gibbs 4159, H. 25451), Falls above Lumu (Cl. 29934), Dallas-Tenompok ridge (Cl. 28339).

Very variable in the size, shape, and texture of the sterile leaves.

PLATYCERIUM Desvaux.

P. coronarium (König) Desv.—Dallas (Cl. 26495).

MERINTHOSORUS Copeland

Phil. Journ. Sci. 6C: 92. 1911.

M. drynarioides (Hook.) Copel l.c., *Dryostachyum* Index.—Kiau, on tree (H. 25624), Tenompok (Cl. 29011).

PHOTINOPTERIS Presl.

P. speciosa Pr.—Koung, banks of the Tampussuk river (Gibbs 4338, t. Gepp, not seen; Cl. 26005). On rocks by the river at Koung, and also higher up, below Dallas.

LECANOPTERIS Reinwardt.

L. carnosa (Reinw.) Bl.—Tenompok (Cl. 27793, 29469).

AGLAOMORPHA Schott.

A. splendens (J. Sm.) Copel. Phil. Journ. Sci. 6C: 141. 1911.—Tenompok (Cl. 29037, 29038).

DRYNARIA (Bory) J. SMITH.

D. sparsisora (Desv.) Moore.—Tenompok (Cl. 28684).

ANTROPHYUM.

A. parvulum Bl.—Kota Belud to Kabayau (Tp. 1495), Tenompok (Cl., s.n.).

The Tenompok specimen agrees with *A. immersum* var. *spathulinum* Mett. Ann. Mus. Lugd. Bat. 4: 171, pl. 7 f. 4–6. 1869. This is probably a form of *A. parvulum*. Most Malayan ferns referred to *A. immersum* seem to be different from the genuine *A. immersum* from the Mascarenes, and should rather be referred to *A. parvulum*.

A. Lessonii Bory, Dup. Voy. Bot. 225, pl. 22 f. 2. 1829.—Dallas, ravine, on rocks and trunks (Cl. 27402).

The specimen exactly matches Bory's original figure. This form has been united with *A. plantagineum* by almost all writers, but it is no doubt different from the type of the latter species (Guam, Herb. Cavanilles !). *A. Lessonii* is distinct in its long-stalked, ovate or broadly ligulate fronds, which approach small forms of *A. latifolium* Bl. *A. plantagineum* with its lanceolate, short-stalked fronds, was excellently figured by Bory, l.c., fig. 1. *A. simulans* v.A.v.R. Bull. Jard. bot. Buitenz. II ser. XI: 2. 1913 from Sumatra (Matthew !) is probably *A. Lessonii;* Kaudern 47 from Celebes is the same.

A. semicostatum Bl.—Near Dallas, on rock by stream (H. 25150), Kamborangah, on trees near stream (H. 25536), Tenompok (Cl. 29417), Dallas, east ravine (Cl. 27455, 27040).

A. coriaceum Wall.—Dallas, on tree in East ravine (Cl. 27441).

The determination is somewhat doubtful. *A. coriaceum* is the Malayan plant commonly called *A. reticulatum*, but is different from the latter species, which is Polynesian.

A. callifolium Bl.—Below Dallas, on rocks and trees by stream (H. 25362, Cl. 26384, 27137, 27492).

var **magnum** C. Chr., var. nov. Fronds of mature plants very broadly spathulate, to about 45 cm. long and 12–15 cm. wide, the widest part just below the apex; the apex shortly acute, with occasionally short acute lobes on either side of it. Younger plants not clearly distinct from typical *A. callifolium*.

Bettotan, near Sandakan (Boden Kloss 18726). Kinabalu: Dallas (Cl. 27454).

Among a large number of collections of *A. callifolium* from the Malay Peninsula, none have fronds of this peculiar shape; this would indicate that var. *magnum* is not the normal fully adult form of the species, but is probably a

local race. It is possible that the other specimens referred above to *A. callifolium* are younger plants, but there is no definite evidence of this. Plants of *Antrophyum* appear to produce fertile leaves of small size from an early age; this is one reason why they are not easy to discriminate systematically. (R.E.H.).

VITTARIA Smith.

V. angustifolia Bl.—*V. angustata* v.A.v.R. Bull. Jard. bot. Buitenz. II ser. XVIII: 43. 1918.—Near Tenompok, on mossy tree trunk (H. 25437), Kamborangah (Cl. 27953), Dallas, East ravine (Cl. 27441A).

V. elongata Sw.—Koung to Kabayau (Tp. 1908), Lobang (Cl. 10325), Tenompok (H. 25419, Cl. 29581, 27512).

V. zosterifolia Willd. (type from Mascarenes) appears to be identical with this species.

V. lineata (L.) Sw.?—Kiau (Cl. 10007), s.l. (Haslam).

I do not know what name should be given to this Malayan form; it is hardly conspecific with the American *V. lineata.*

V. ensiformis Sw.?—Dallas (Cl. 27443), Tenompok (Cl. 28185).

MONOGRAMMA Schkuhr.

M. trichoidea J. Sm.—Tenompok, on tree in forest (H. 25715, Cl. 29574).

INDEX

New species, new varieties, new combinations, new names in **bold-faced** type, synonyms in *italics*.

Acrophorus Blumei Ching, nom. nov. 226
Acrophorus stipellatus C. Chr. 226
Acrosorus exaltatus Copel. 298
,, *Frederici et Pauli* Copel. 298
,, *triangularis* Copel. 298
Adiantum diaphanum Bl, 285
Aglaomorpha splendens (J.Sm.) Copel. 314
Alsophila amaiambitensis v.A. v.R. 220
,, *commutata* Mett. 220
,, *crinita* Gepp 221
,, *dubia* Bedd. 219
,, *Hallieri* v.A.v.R. 220
,, *glauca* (Bl.) J.Sm. 222
,, *glabra* Bak. 220
,, *Margarethæ* Schr. 220
,, *ramispina* Hk. 220.
,, *Ridleyi* Bak. 219
,, *vexans* Cesati 218
Angiopteris angustifolia Presl 209
,, Brooksii Copel. 209
,, Ferox Copel. 209
,, **Holttumii** C. Chr. 209
Anisogonium grossum Pr. 274
Antrophyum callifolium Bl, 315
,, callifolium var. magnum C. Chr. 315
,, coriaceum Wall. 315
,, Lessonii Bory 315
,, parvulum Bl. 315
,, semicostatum Bl. 315
Arthropteris obliterata (R.Br.) J. Sm. 239
Aspidium adnatum Bl. 252
,, *circutarium*, subsp. *coadunatum* C. Chr. 260
,, *microthecium* Fée 243
,, *pachyphyllum* Kze 260
,, *pleiosorum* v.A.v.R. 260
,, *profereoides* Chr. 258
,, *pteropodum* Diels 308
,, *terminale* Rosenst. 261
,, *trifolium* v.A.v.R. 261
Asplenium acutiusculum Bl. 280
,, adiantoides (L.) C. Chr. 280
,, batuense v.A.v.R. 275
,, Belangeri (Bory) Kze. 278
,, *biseriale* Bak. 269
Asplenium borneense Hk. 278
,, *Brooksii* Copel. 275
,, *cuspidifolium* v.A.v.R. 276
,, dichotomum Hk. 283
,, Elmeri Chr. 283
,, *falcatum* Lam. 280
,, filiceps Copel. 276
,, filipes Copel. 278
,, fuliginosum Hk. 280
,, *glochidiatum* Racib. 275
,, *Grashoffii* Rosenst. 275
,, horizontale Bak. 277
,, **kinabaluense** Holt. 281, plate 62
,, **Klossii** C. Chr. 278, plate 60
,, *laserpitiifolium* Bak. 283
,, **lobangense** C. Chr. 279
,, **malayo-alpinum** Holt. 280, plate 61
,, *matangense* Hose. 270
,, nidus L. 275
,, nidus var. ellipticum (Fee) 275
,, nidus var. phyllitidis (Don) 275
,, nigrescens Bl. 280
,, normale Don. 278
,, **pachychlamys** C. Chr. 277
,, planicaule Wall. 280
,, porphyrorachis Bak. 279
,, *prolificans* v.A.v.R. 276
,, *repandum* Willd. 260
,, scolopendrioides J. Sm. 275
,, spathulinum J. Sm. 282
,, spathulinum var. amaurolobum Rosenst. 282.
,, squamulatum Bl. 276
,, subnormale Copel. 279
,, tenerum Forst. 277
,, tenerum var. retusum C. Chr. 277
,, trifoliatum Copel. 276
,, unilaterale Lam. 278
Athyrium amœnum C. Chr. 267, plate 56
,, atropurpureum Copel. 267

Athyrium atrosquamosum Copel. 274
,, *biseriale* Copel. 269
,, Clemensiæ Copel. 266
,, *Hewittii* Copel. 273
,, macrocarpum (Bl.) Bedd. 266
,, *maximum* Copel. 273
,, moultoni Copel. 267
,, *pariens* Copel. 274
,, *porphyrorachis* Copel. 279
,, pulcherrimum Copel. 267
,, silvaticum (Bl.) Milde 268
,, *tabacinum* Copel. 274

Balantium Copelandii Chr. 224
Blechnum Finlaysonianum Wall. 284
Blechnum fluviatile (R.Br.) Lowe 283
,, Fraseri (Cunn.) Luerss var. philippinense Chr. 284
,, orientale L. 284
,, Patersoni (R.Br.) Mett. 283
,, procerum (Forst.) Sw. 283
,, vestitum (Bl.) Kuhn 284
Botrychium daucifolium Wall. 208

Calymmodon cucullatum Pr. 297
,, *gracilis* (Fée) Copel. 298
Campium quoyanum (Gaud.) Copel. 262
,, subsimplex (Fée) Copel. 261
Cheilanthes tenuifolia (Burm.) Sw. 285
Cheiropleuria bicuspis (Bl.) Pr. 314
Cibotium Cumingii Kze. var. **arachnoideum** C. Chr. 224
Coniogramme fraxinea (Don.) Diels 284
,, macrophylla (Bl.) Hieron. var. Copelandi Hieron 284
Culcita Copelandii (Chr.) Maxon 224
Cyathea alternans (Wall.) Pr. 219
,, Burbidgei (Bak.) Copel. 220
,, capitata. Copel. 218
,, *celebica* Gepp. 222
,, contaminans (Wall.) Copel. 222
Cyathea crinita Copel. 221
,, *dubia* Copel. 219
,, *dulitensis* Gepp. 221
,, *elliptica* Copel. 219
,, Havilandii Bak. 221
,, kemberangana Copel. 219
,, kinabaluensis Copel. 218
,, Korthalsii Mett. 222
,, latebrosa (Wall.) Copel. 222
,, longipes Copel. 222
,, megalosora Copel. 221
,, paleacea Copel. 221
,, polypoda Bak. 219
,, ramispina (Hk.) Copel. 220
,, recommutata Copel. 220
,, *rigida,* Copel. 221
,, squamulata (Bl.) Copel. 219
,, *Toppingii* Copel. 220
,, tripinnata Copel. 222
,, **vexans** (Ces.) C. Chr. 218
Cyclopeltis Presliana (J. Sm.) Berk. 258
Cyclophorus adnascens (Sw.) Desv. 313
,, borneensis Copel. 313
,, Christii (Gies.) C. Chr. 313
,, flocciger (Bl.) Pr. 313
,, varius (Klf.) Gaud. 313
Cystodium sorbifolium (Sm.) J. Sm. 239

Davallia alata Bl. 303
,, *contigua* Spr. 303
,, embolostegia Copel. 233
,, *Emersoni* Hk. & Grev. 303
,, *exaltata* Copel. 298
,, *Frederici et Pauli* Chr. 298
,, *Hosei* Bak. 233
,, Lobbiana Moore 233
,, Lorrainii Hance 233
,, *luzonica* Hk. 233
,, *nephrodioides* Bak. 230
,, *oligophlebia* Bak. 233
,, *Veitchii* Bak. 234
Davallodes borneense (Hk.) Copel. 230
,, **Burbidgei** C. Chr. 230
Davallodes nephrodioides Copel. 230
Dennstædtia ampla (Bak.) Bedd. 227
,, cuneata (J. Sm.) Moore 227
,, *gomphophylla* (Bak.) C. Chr. 227

Dennstædtia rufidula C. Chr. 226, plate 51
,, scabra (Wall.) Moore var. **tenuisecta** C. Chr. 227
Diacalpe aspidioides Bl. 226
Dicksonia Blumei (Kze.) Moore 223
Dicksonia Copelandii Chr. 224
Didymochlæna truncatula (Sw.) J.Sm. 254
Diplaziopsis javanica (Bl.) C. Chr. 275
Diplazium asperum Bl. 274
,, **atrosquamosum** (Copel.) C. Chr. 274
,, bantamense Bl. var. alternifolium (Bl.) 274
,, **barbatum** C. Chr. 272, plate 59
,, *biseriale* C. Chr. 269
,, Christii C. Chr. 270
,, cordifolium Bl. 274
,, cordifolium Bl. var. pariens (Copel.) 274
,, crenatoserratum Bl. 269
,, dilatatum Bl. 273
,, **falcinellum** C. Chr. nom. nov. 270
,, fraxinifolium Pr. var. grossum (Pr.) 274
,, grammitoides Pr. 269
,, Hewittii (Copel.) C. Chr. 273
,, **lævipes** C. Chr. 271, plate 58
,, *maximum* C. Chr. 273
,, pallidum (Bl.) Moore 269
,, **poiense** C. Chr. 269
,, polypodioides Bl. 274
,, *porphyrorachis* Diels 279
,, speciosum Bl. 271
,, tabacinum Copel. 274
,, **tricholepis** C. Chr. 270, plate 57
,, vestitum Pr. var. **borneense** C. Chr. 273
Dipteris conjugata Reinw. 314
Drymoglossum piloselloides (L.) Pr. 314
Drynaria sparsisora (Desv.) Moore. 315
Dryopteris aciculata (Bak.) C. Chr. 253
,, adnata (Bl.) v.A.v.R. 252
,, arida (Don.) O. Ktze. 245
Dryopteris badia v.A.v.R. 241
,, **baramensis** C. Chr. 246
,, *borneensis* O. Ktze. 250
,, Boryana (Willd.) C. Chr. 254
,, *brevipinna* C. Chr. 248
,, callosa (Bl.) C. Chr. 245
,, contigua Rosenst. 244
,, crassifolia (Bl.) O. Ktze. 242
,, crassifolia (Bl.) O. Ktze var. **purpureolilacina** C. Chr. 242
,, dissecta (Forst.) O. Ktze. 253
,, exsculpta (Bak.) C. Chr. 248
,, ferox (Bl.) O. Ktze. 246
,, *filix mas* Copel. 252
,, *filix mas* subsp. *patentissima* (Wall.) C. Chr. 250
,, firmula (Bak.) C. Chr. 249
,, gracilescens (Bl.) O. Ktze 240
,, *gymnopoda* C.Chr. 240
,, Hasseltii (Willd.) C. Chr. 254
,, heterocarpa (Bl.) O. Ktze 244
,, hirtipes (Bl.) O. Ktze. 250
,, Hosei (Bak.) C. Chr. 248
,, immersa (Bl.) O. Ktze. 243
,, inconspicua Copel. 242
,, *kinabaluensis* Copel. 240
,, labuanensis C. Chr. 249
,, *laserpitiifolia* (Scort.) C. Chr 254
,, lithophylla Copel. 245
,, **lobangensis** C. Chr. 245
,, megaphylla (Nett.) C. Chr. 246
,, *Metteniana* Hieron. 243
,, microthecia (Fée) C. Chr. 243
,, mirabilis Copel. 249
,, multiseta (Bak.) C. Chr. 243
,, **multisora** C. Chr. 241
,, oosora (Bak.) C. Chr. 245
,, paleacea (Sw.) C. Chr. 250
,, parasitica (L.) O. Ktze. 244
,, polita Rosenst. 252

Dryopteris porphyricola Copel. 244
,, *Ridleyi* (Bedd.) C. Chr. 240
,, setigera (Bl.) O. Ktze 243
,, sparsa (Ham.) O. Ktze 252
,, stegnogramme (Bl.) C. Chr. 250
,, subarborea (Bak.) C. Chr. 252
,, subpubescens (Bl.) C. Chr. 244
,, *subsagenoides* v.A. V.R. 243
,, **supravillosa** C. Chr. 241
,, *tabacicoma* v.A.v.R. 252
,, **tenompokensis** C. Chr. 248
,, Toppingii Copel. 246
,, truncata (Poir.) O. Ktze 246
,, unita (L.) O. Ktze. 245
,, urophylla (Wall.) C. Chr. var. **nitida** Holt. 249
,, *Vangenderenstortii* v. A.v.R. 243
,, viscosa (J. Sm.) O. Ktze. 240
,, viscosa (J. Sm.) O. Ktze. var. **kamborangana** Chr. 240

Elaphoglossum angulatum (Bl.) Moore 290
,, Beccarianum (Bak.) C. Chr. 289
,, callifolium (Bl.) Moore 289
,, Cumingii (Fée) Moore 290
,, decurrens (Desv.) Moore 290
,, decurrens var. **crassum** C. Chr. 290
,, *laurifolium* auctt. 290
,, petiolatum (Sw.) Urb. 291

Gleichenia arachnoides Gepp 212
,, **borneensis** (Bak.) C. Chr. 211
,, bullata Moore 212
,, *circinnata* var. *borneensis* Bak. 211
,, glauca Thbg. 212
,, hirta Bl. 211
,, lævigata (Willd.) Hk. 212

Gleichenia linearis (Burm.) Clarke 212
,, microphylla R. Br. 210
,, Norrisii Mett. var. **floccigera** C. Chr. 212
,, *vestita* var. *paleacea* Bak. 211
,, *vulcanica* Gepp. 210
Gymnogramme avenia Bak. 312

Helminthostachys zeylanica (L.) Hk. 209
Heterogonium profereoides (Chr.) Copel. 258
Histiopteris incisa (Thbg.) J. Sm. 289
,, integrifolia Copel. 289
,, stipulacea (Hk.) Copel. 289
,, stipulacea var. integrifolia (Copel.) C. Chr. 289
Humata alpina (Bl.) Moore 231
Humata intermedia C. Chr. 231
,, kinabaluensis Copel. 232
,, kinabaluensis var. **subvestita** C. Chr. 232
,, *nephrodioides* v.A.v.R. 230
,, repens (L.fil.) Diels. 231

Hymenolepis revoluta Bl. 313
,, revoluta var. planiuscula (Mett.) Hieron. 313
,, squamata Hieron. var. borneensis C. Chr. 313

Hymenophyllum aculeatum Gebb 215
Hymenophyllum australe Willd. 213
,, badium Hk. & Grev. 214
,, Bakeri Copel. 214
,, blandum Racib. 214
,, Blumeanum Spr. 213
,, *borneense* Hk. 216
,, cardunculus C. Chr. 215
,, *Clemensiæ* Copel. 213
,, denticulatum Sw. 215
,, eximium Kze. 213
,, *formosum* Bak. 213
,, *fraternum* Gepp. 215
,, holochilum (v.d.B.) C. Chr. 214
,, johorense Holt. 214
,, Lobbii Moore 214, 215

Hymenophyllum microchilum (Bak.) C. Chr. 212
,, Neesii (Bl.) Hk. 215
,, *obtusum* Bak. 213
,, pachydermicum Cesati 213
,, paniculiflorum Pr. 213
,, perfissum Copel. 214
,, *physocarpum* Chr. 215
,, **pilosissimum** C. Chr. 213
,, productum Kze. 214
,, serrulatum (Pr.) C. Chr. 215
,, *subflabellatum* Ces. 214
,, thuidium Harr. 215
,, *vestitum* Bak. 213
Hypolepis Brooksiæ v.A.v.R. 229
,, puncta (Thbg.) Mett.
,, tenuifolia (Forst.) Bernh. 229

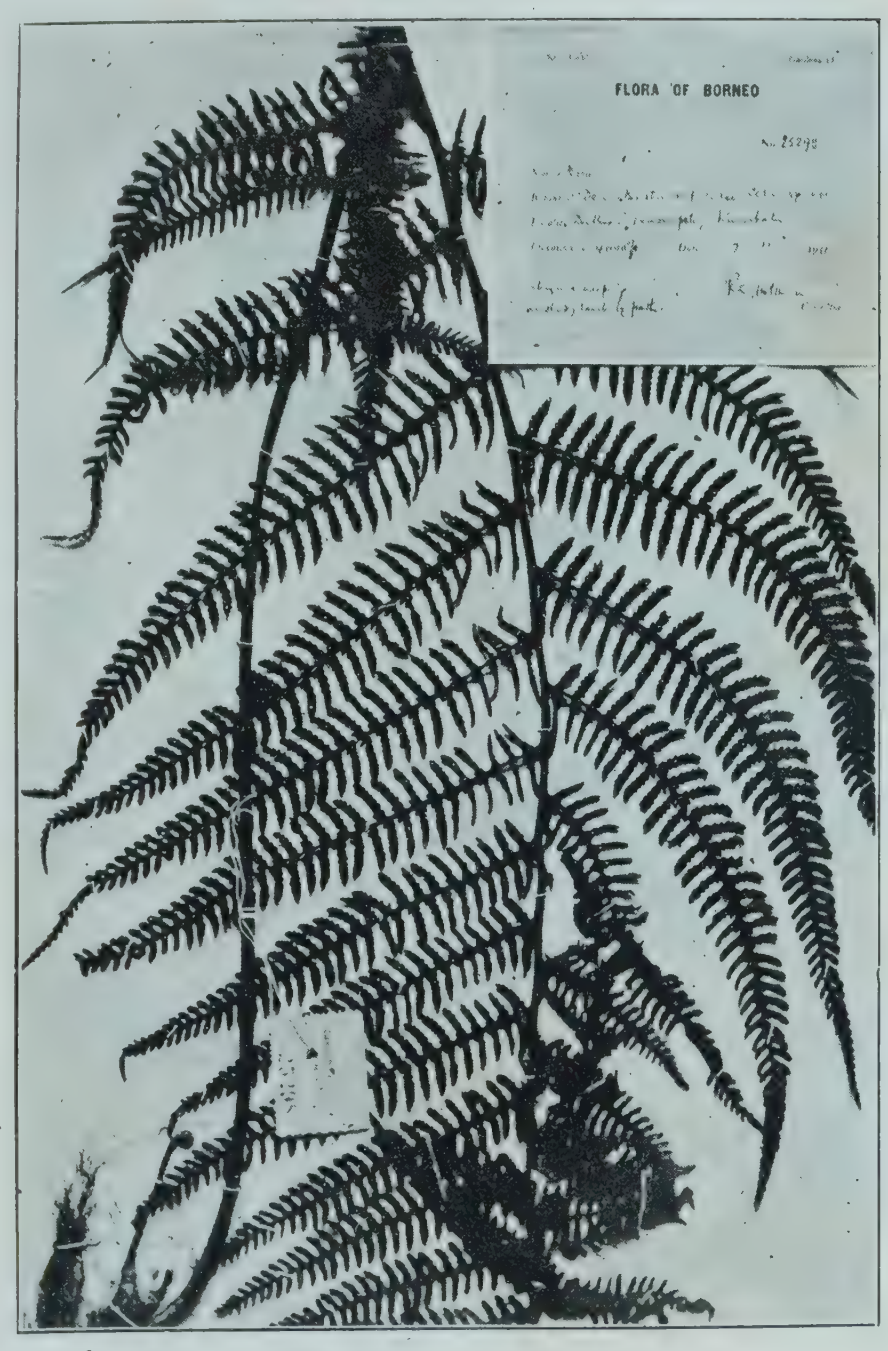
Lecanopteris carnosa (Reinw.) Bl. 314
Leptochilus cuspidatus C. Chr. 262
Leptochilus exsculptus C. Chr. 248
Leptoselliguea C. Chr. subgen. nov. 309
Leucostegia hymenophylloides (Bl.) Bedd. 231
Leucostegia immersa (Wall.) Pr. 231
Leucostegia nephrodioides Copel. 230
Lindsaya borneensis Hk. 235
Lindsaya concinna J. Sm. 235
,, crispa Bak. 238
,, davallioides Bl. 238
,, decomposita Willd. 236
,, diplosora v.A.v.R. var. **acrosora** C. Chr. 235
,, *gomphophylla* Bak. 235
,, *impressa* Chr. 238
,, **kinabaluensis** Holt. 237
,, *lancea* auctt. 235
,, nitida Copel. 237
,, parallelogramma v.A. v.R. 238
,, *pectinata* Bak. 235
,, pectinata Bl. 235
,, plumula Ridl. 234
,, recurvata Wall. 236
,, repens Bedd. 235
,, scandens Hk. 235
,, tenera Dry. 235
Lomagramma Brooksii Copel. 265
Lomariopsis leptocarpa Fée 262
Loxogramme antrophyoides (Bak) C. Chr. 312
,, avenia (Bl.) Pr. 312
,, *Blumeana* Pr. 312
,, ensifrons v.A.v.R. 311, 312
,, involuta Pr. var. gigas Copel. 312
,, *iridifolia* (Chr.) Copel. 311
,, **nidiformis** C. Chr. 312
,, parallela Copel. 311
Lygodium circinnatum (Burm.) Sw. 210
,, scandens (L.) Sw. 210
Marattia pellucida Pr. 209
Matonia Foxworthyi Copel. 223
Merinthosorus drynarioides (Hk.) Copel. 314
Mesochlæna Toppingii Copel. 254
Microlepia Hookeriana (Wall.) Pr. 228
,, manilensis Pr. 228
,, Ridleyi Copel, 228
,, speluncæ (L.) Moore var. vilosissima C. Chr. 229
,, strigosa (Thbg.) Pr. 228
Monachosorum subdigitatum (Bl) Kuhn 226
Monogramme trichoidea J. Sm. 316
Nephrodium gymnopodum Bak. 240
Nephrodium pteropodum Bak. 308
Nephrolepis acuminata (Houtt) Kuhn 239
,, barbata Copel. 239
,, hirsutula (Forst.) Pr. 239
,, *marginalis* Copel. 228
,, radicans (Burm.) Kuhn 239
Odontosoria 234
Oleandra oblanceolata Copel. 239
Ophioglossum intermedium Hook. 208
,, Moultoni Copel. 208
,, pedunculosum Desv. 208
,, pendulum L. 208
,, reticulatum L. 208
Oreogrammitis Clemensiæ Copel. 292
Pæsia radula (Bak.) C. Chr. 229
Photinopteris speciosa Pr. 314
Pityrogramma calomelanos (L.) Link. 284

Plagiogyria adnata (Bl.) Bedd 225
,, Clemensiæ Copel. 225
,, glauca (Bl.) Mett. 225
Plagiogyria integripinnata Bonap. 224
,, pycnophylla (Kze.) Mett. 224
,, *pycnophylla* var. *integra* Bonap. 224
,, *rotundipinnata* Bonap. 224
,, *subrigida* v.A.v.R. 224
,, *sumatrana* Rosenst. 224
,, tuberculata Copel. 224
Platycerium coronarium (Koenig.) Desv. 314
Pleopeltis tænitidis v.A.v.R. 310
Polypodium accedens Bl. 307
,, *acrosoroides* v.A.v.R. 303
,, albidopaleatum Copel 307
,, albidosquamatum Bl. 311
,, alternidens Cesati 299
,, *angustatum* Bl. 309
,, *blechnoides* Bak. 300
,, bongœnse Copel. 295
,, brachypodium Copel. 305
,, *Brooksii* Copel. 295
,, bryophyllum v.A.v.R. 299
,, cæspitosum (Bl.) Mett. 293
,, calcipunctatum Copel. 297
,, carvifolium (Kze.) Pr. 258
,, celebicum Bl. 303
,, ciliiferum v.A.v.R. 293
,, clavifer Hk. 298
,, *Clemensiæ* Copel. 307
,, commutatum Bl. 309
,, congenerum (Bl.) Pr. 296
,, consociatum v.A.v.R. 298
,, contiguum (Forst.) J. Sm. 303
,, *costulatum* Bak. 311
,, cucullatum Nees & Bl. 297
,, cucullatum var. *subgracillimum* (v.A. v.R.) C. Chr. 297
,, Curtisii Bak. 304
,, davalliaceum Bak. 303
,, *decrescens* Chr. 304
Polypodium denticulatum (Bl.) Pr. 300
,, dolichosorum Copel. 294
,, *durum* Copel. 293
,, *ebenipes* Bak. 310
,, **Emersoni** (Hk. & Grev.) C. Chr. 303
,, *exaltatum* Copel. 298
,, fasciatum (Bl.) Pr. 293
,, fluviatile Lauterb. 308
,, *Griffithianum* var. *borneense* Ch. 310
,, halconense Copel 304
,, Havilandii Bak. 296
,, heracleum Kze 311
,, heterocarpum Bl. 308
,, Hieronymusii C. Chr. 300
,, *hirtellum* Copel. 295
,, incurvatum Bl. 311
,, insigne Bl. 309
,, integriore Copel. 305
,, integriore var. rajaense C. Chr. 305
,, interruptum C. Chr. 308
,, ithycarpum Copel. 309
,, **kamboranganum** C. Chr. 306
,, khasyanum Hk. 303
,, kinabaluense Copel. 292
,, *laciniatum* Bak. 310
,, lasiosorum (Bl.) Hk. 294
,, *lasiosorum* Gepp 295
,, *ludens* Bak. 294
,, *macrochasmum* Copel 310
,, malaicum v.A.v.R. 292
,, millefolium Bl. 304
,, *minutum* Bak. 301
,, minutum Bl. 300
,, mollicomum Nees & Bl. 301
,, *monocarpum* Rosenst. 303
,, *Moseleyi* Bak. 310
,, Moultoni Copel. 300
,, *multisorum* Copel. 296
,, *muscoides* Copel. 298
,, nutans Bl. 302
,, obliquatum Bl. 303
,, obscurum (Bl.) Mett. 294
,, padangense Bak. 293

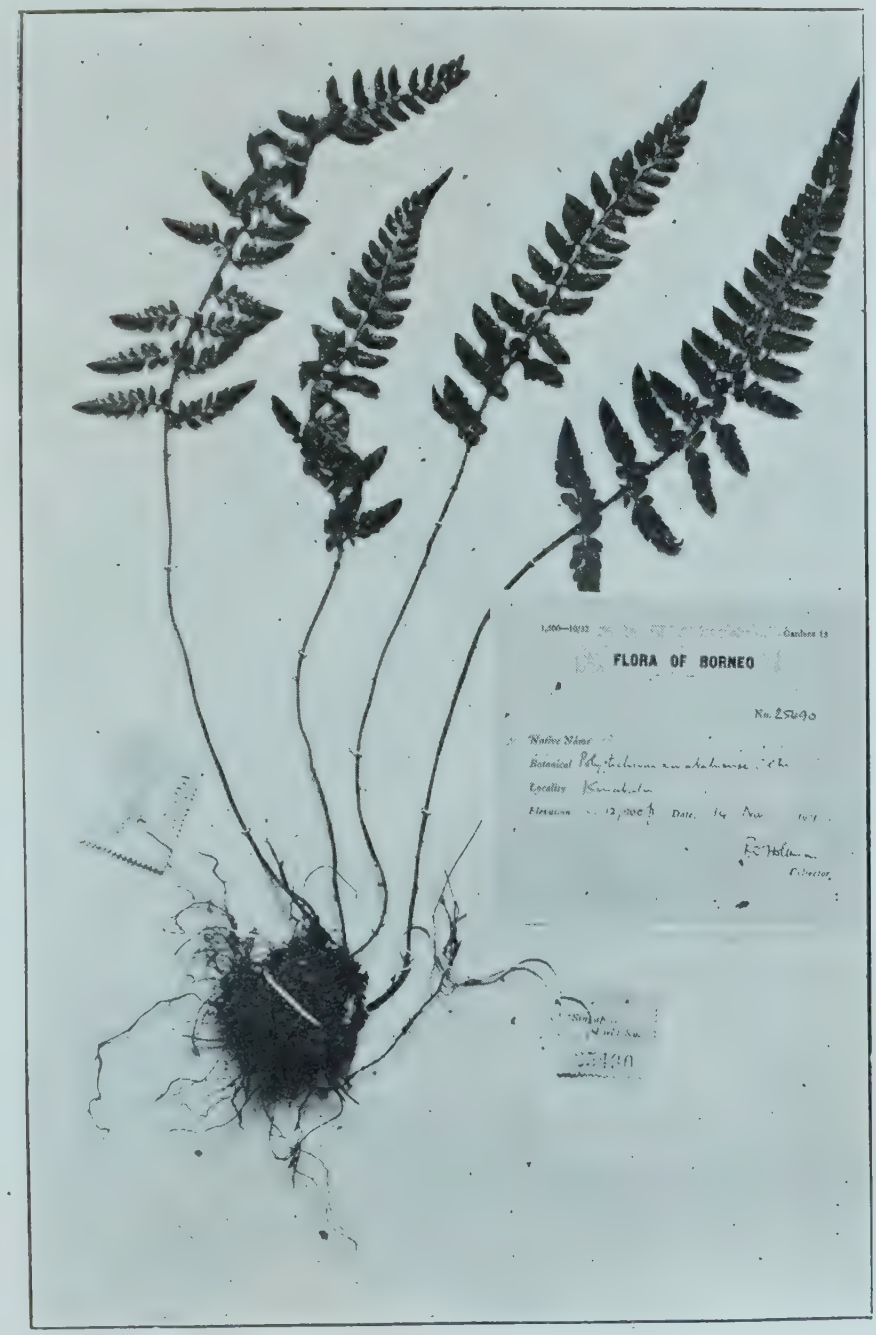
Polypodium pakkænse C. Chr. 310
,, pallens Bl. 305
,, *palmatum* auctt. 309
,, papillatum v.A.v.R. 299
,, papillosum Bl. 304
,, *peltatum* v.A.v.R. 307
,, platyphyllum Sw. 308
,, *pleiosoroides* Gepp. 297
,, polysorum Brause 308
,, *pseudorevolvens* v.A. v.R. 300
,, *pubinerve* Chr. 295
,, *pulcherrimum* Copel. 304
,, puncticulatum v.A. v.R. 257
,, *quinquefidum* Bak. 310
,, *rajænse* C. Chr. 305
,, Reinwardtii (Bl.) Pr. 295
,, *repandulum forma pilosa* v.A.v.R. 301
,, *revolvens* v.A.v.R. 300
,, rupestre Bl. 307
,, *Sarasinorum* v.A.v.R. 298
,, sarawakense Bak. 307
,, *Scortechinii* Bak. 308
,, *serræforme* (Wall.) J. Sm. 303
,, *sessifolium* Hk. 292
,, setigerum Bl. 296
,, sinuosum Wall. 311
,, *soridens* Bak. 307
,, stenophyllum Bl. 307
,, stenopteris Bak. 307
,, streptophyllum Bak. 298
,, subauriculatum Bl. 305
,, subminutum v.A.v.R. emend. Holt. 301
,, subpinnatifidum Bl. 299
,, *subpleiosorum* Racib. 297
,, *subserratum* Hk. 279
,, subsparsum Bak. 307
,, sumatranum Bak. 297
,, tæniatum Sw. 309
,, tæniatum var. borneense (Chr.) C. Chr. 310
,, tæniatum var. palmata (Bl.) C. Chr. 310
Polypodium tæniophyllum Copel. 307
,, taxodioides Bak. 304
,, *triangulare* Scort. 298
,, venulosum Bl. 303
,, verrucosum Wall. 306
,, Warburgii Chr. 295
,, Wrayi Bak. 307
,, Zippelii Bl. 307
,, *Zollingerianum* Kze. 308
Polystichum aristatum (Forst.) Pr. 258
,, **gemmiparum** C. Chr. 256, plate 54
,, **Holttumii** C. Chr. 256, plate 53
,, **kinabaluense** C. Chr. 255, plate 52
,, obtusum J. Sm. 255
,, *truncatulum* v.A.v.R. 253
Prosaptia alata Chr. 303
Prosaptia contigua Pr. 303
Prosaptia davalliaceum Copel. 303
Prosaptia linearis Copel 303
Pteridium esculentum (Forst.) C. C. Chr. 230
Pteris biaurita L. 286
,, Clemensiæ Copel. 285
,, Dalhousiæ Hk. 285
,, decussata J. Sm. 286
,, ensiformis Burm. 285
,, excelsa Gaud. 286
,, flava Goldm. 286
,, Grevilleana Wall. 285
,, **Holttumii** C. Chr. 287
,, **kinabaluensis** C. Chr. 286
,, *longifolia* auctt. 285
,, longipes Don var. Philippinensis (Fée) C. Chr. 286
,, longipinnula Wall. 285
,, purpureorachis Copel. 286
,, *quadriaurita* var. *digitata* Bak. 285
,, rangiferina Pr. var. **scabripes** C. Chr. 285
,, *Toppingii* Copel. 285
,, vittata L. 285
Pycnoloma murudense C. Chr. 311

Saccoloma sorbifolium C. Chr. 239
Schizæa dichotoma (L.) Sw. 210
,, digitata (L.) Sw. 210
,, fistulosa Labill. 210
,, malaccana Bak. var. **robustior** C. Chr. 210

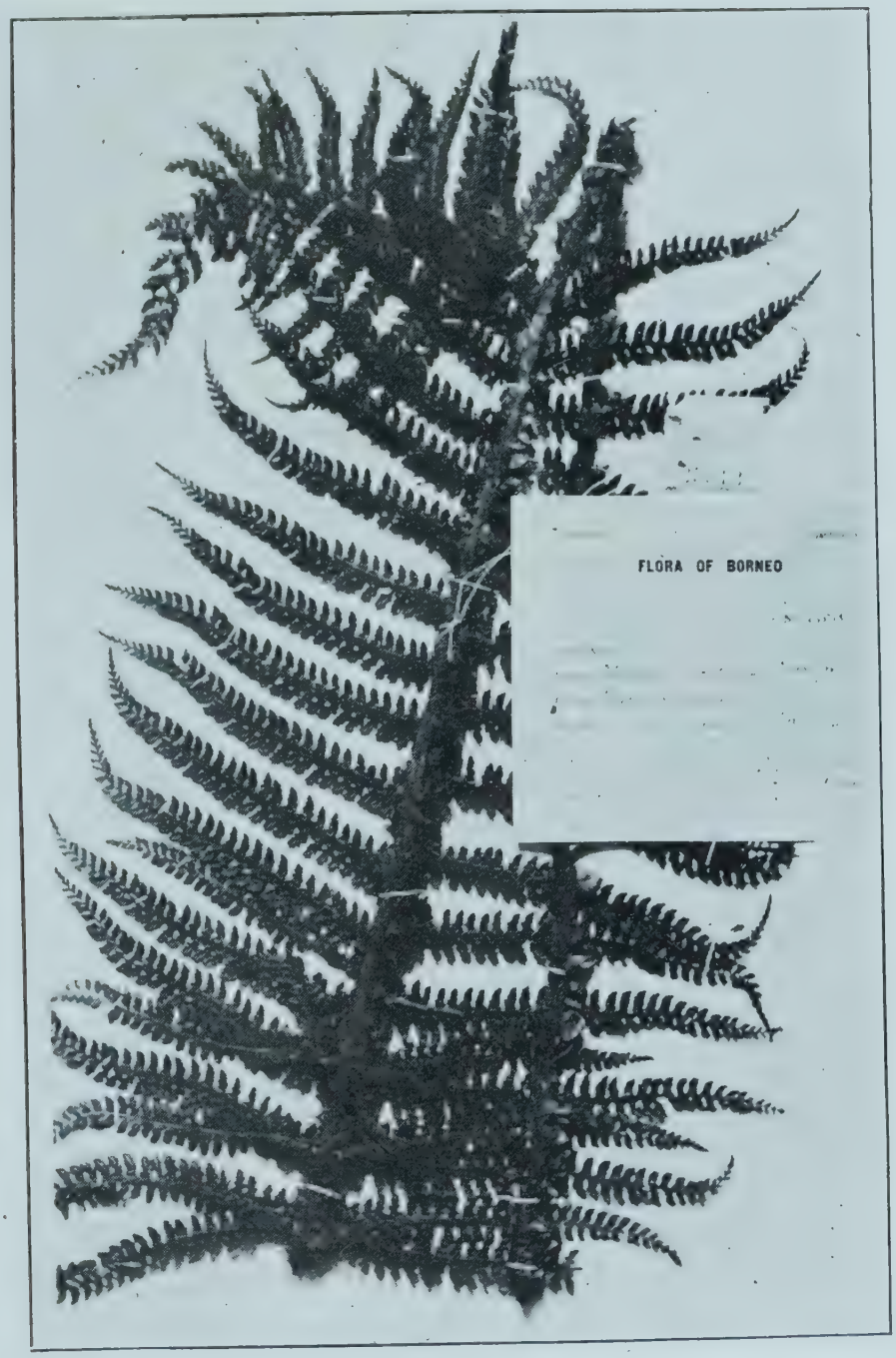
Schizoloma induratum (Bak.) Copel. 234
„ Jamesonoides (Bak.) Copel. 234
Scleroglossum angustissimum Copel. 292
„ debile (Kuhn) v.A. v.R. 291
„ minus (Fée) C. Chr. 292
„ pusillum (Bl.) v.A. v.R. 291
„ pusillum var. angustissimum (Copel.) C. Chr. 292
„ sulcatum (Kuhn) v.A.v.R. 292
Sphenomeris chinensis (L.) Maxon 234
Sphenomeris Veitchii (Bak.) C. Chr. 234
Stenolepia tristis (Bl.) v.A.v.R. 226
Syngramma alismifolia (Pr.) J. Sm. 284
Tænitis blechnoides (Willd.) Sw. 239
Tapeinidium biserratum (Bl.) v. A.v.R. 233
Tapeinidium obligophlebium C. Chr. 233
Tapeinidium pinnatum (Cav.) C. Chr. 233
Tectaria coadunata (Wall.) C. Chr. 260
„ crenata Cav. 260
„ decurrens (Pr.) Copel. 260
„ **Holttumii** C. Chr. 259, plate 55
„ Leuzeana (Gaud.) Copel. 259
„ malayensis (Chr.) Copel. 260
„ **pleiosora** (v.A.v.R.) C. Chr. 260
„ *pteropoda* Copel. 308
„ **trifolia** (v.A.v.R.) C. Chr. 261
„ vasta (Bl.) Copel. 261
Teratophyllum Clemensiæ Holt. 262
Trichomanes album Bl. 217
„ *apiifolium* Bak. 218
Trichomanes apiifolium Pr. 218
„ auriculatum Bl. 217
„ bilabiatum Nees et Bl. 216
„ bipunctatum Poir. 216
„ brevipes Bak. 217
„ cupressoides Desv. 218
„ *denticulatum* Bak. 214
„ dichotomum Kze. 216
„ digitatum Bak. 216
„ *filicula* Bak. 216
„ humile Forst. 216
„ *javanicum* Gepp 218
„ maximum Bl. 217
„ *microchilum* Bak. 212
„ *microlirion* Copel. 217
„ minutum Bl. 216
„ *nitidulum* Gepp. 216
„ pallidum Bl. 217
„ palmatifidum K. Muell. 216
„ papillatum K. Muell. 217
„ pluma Hk. 218
„ proliferum, Bl. 216
„ *proliferum,* Gepp. 216
„ *pyxidiferum* Bak. 217
„ *recedens* Rosenst. 217
„ *rigidum* auctt. 218
„ Schlechteri Brause 218
„ *serrulatum* Bak. 214
„ Teysmanii v.d.B. 216
„ *trichophyllum* Moore 218
Vittaria angustata v.A.v.R. 316
„ angustifolia Bl. 316
„ ensiformis Sw. 316
„ lineata (L.) Sw. 316



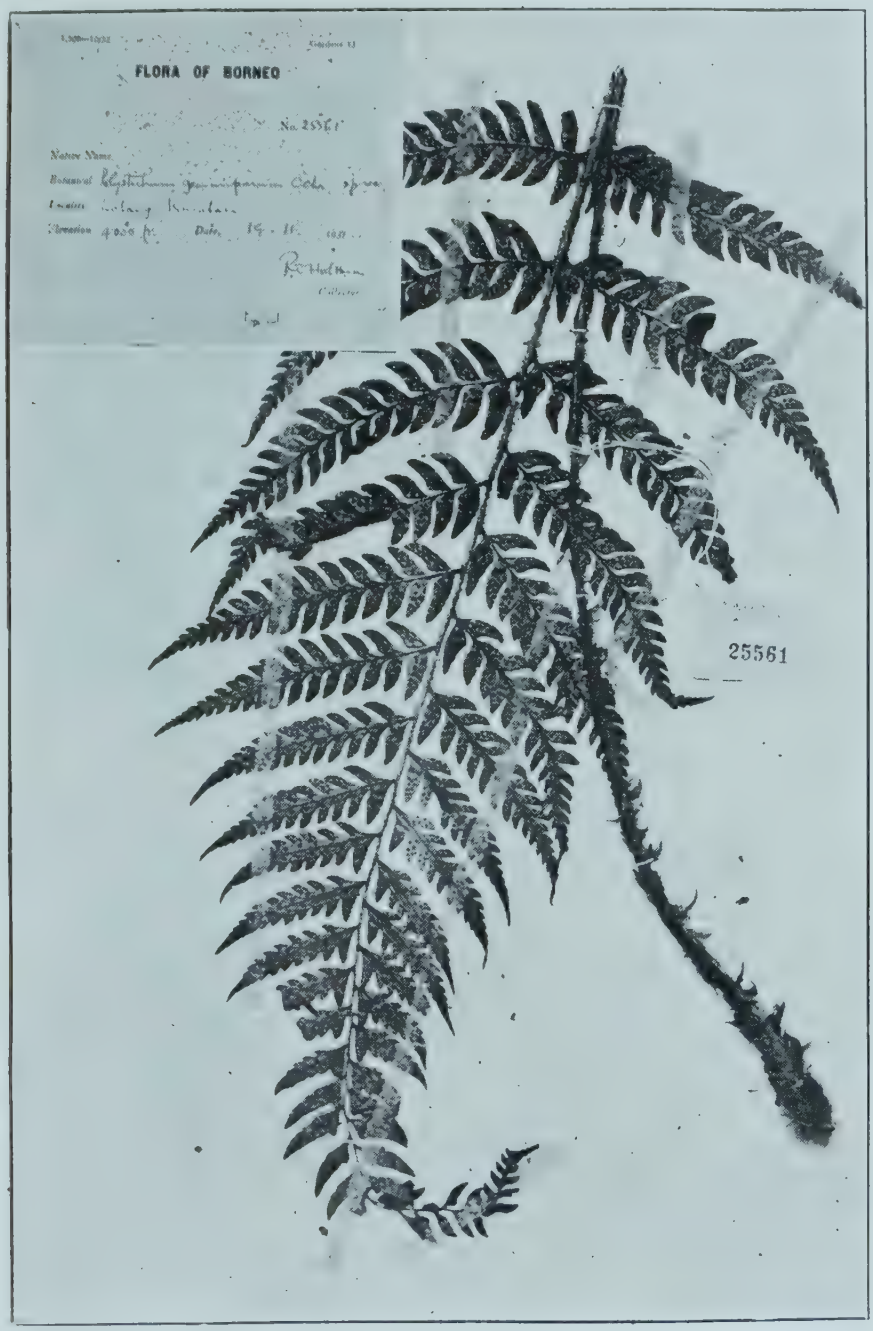
Dennstaedtia rufidula C. Chr. H. 25298, × 1/3.



Polystichum kinabaluense C. Chr. H. 25490, × 1/3.

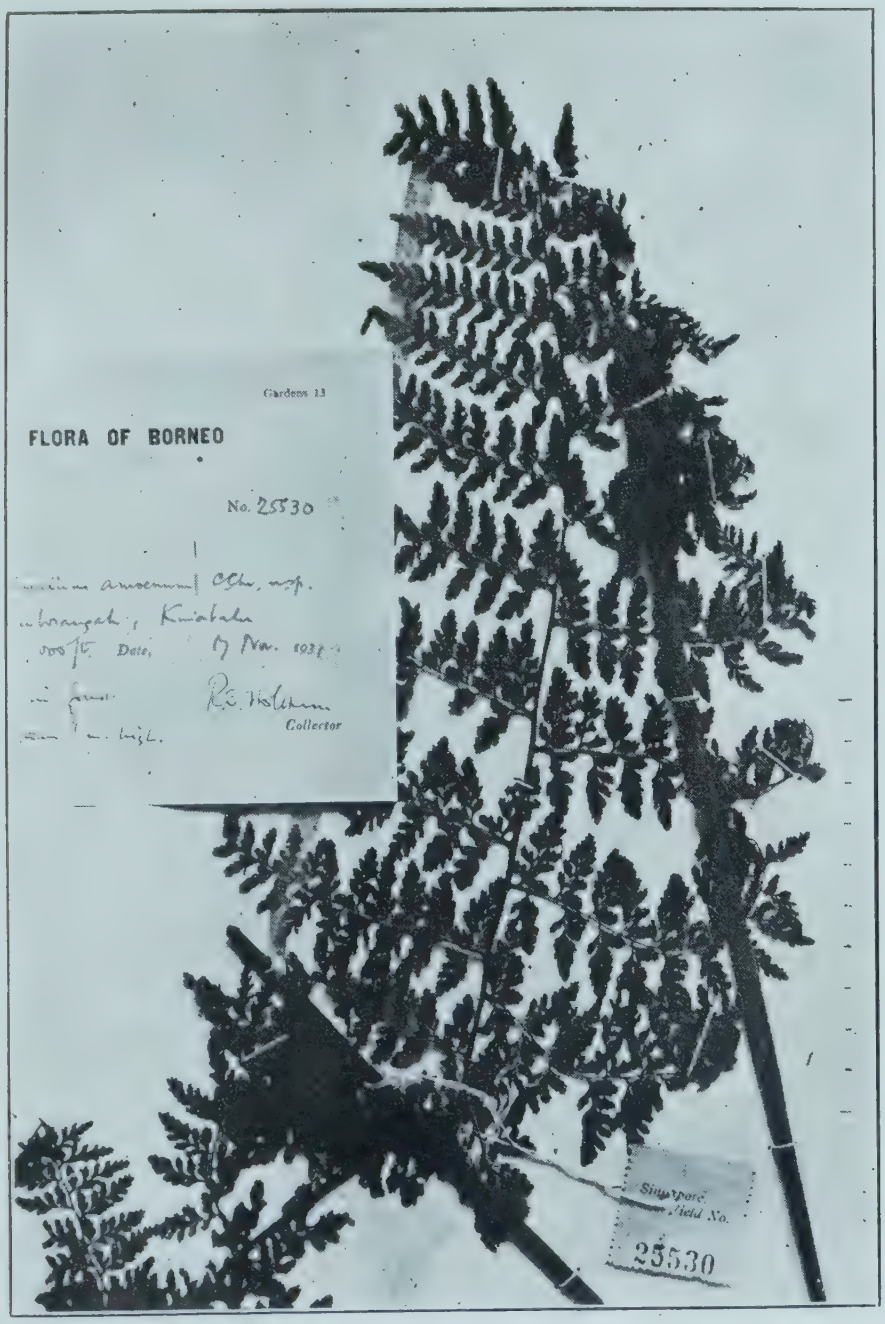


Polystichum Holttumii C. Chr. H.25513, × 1/3.

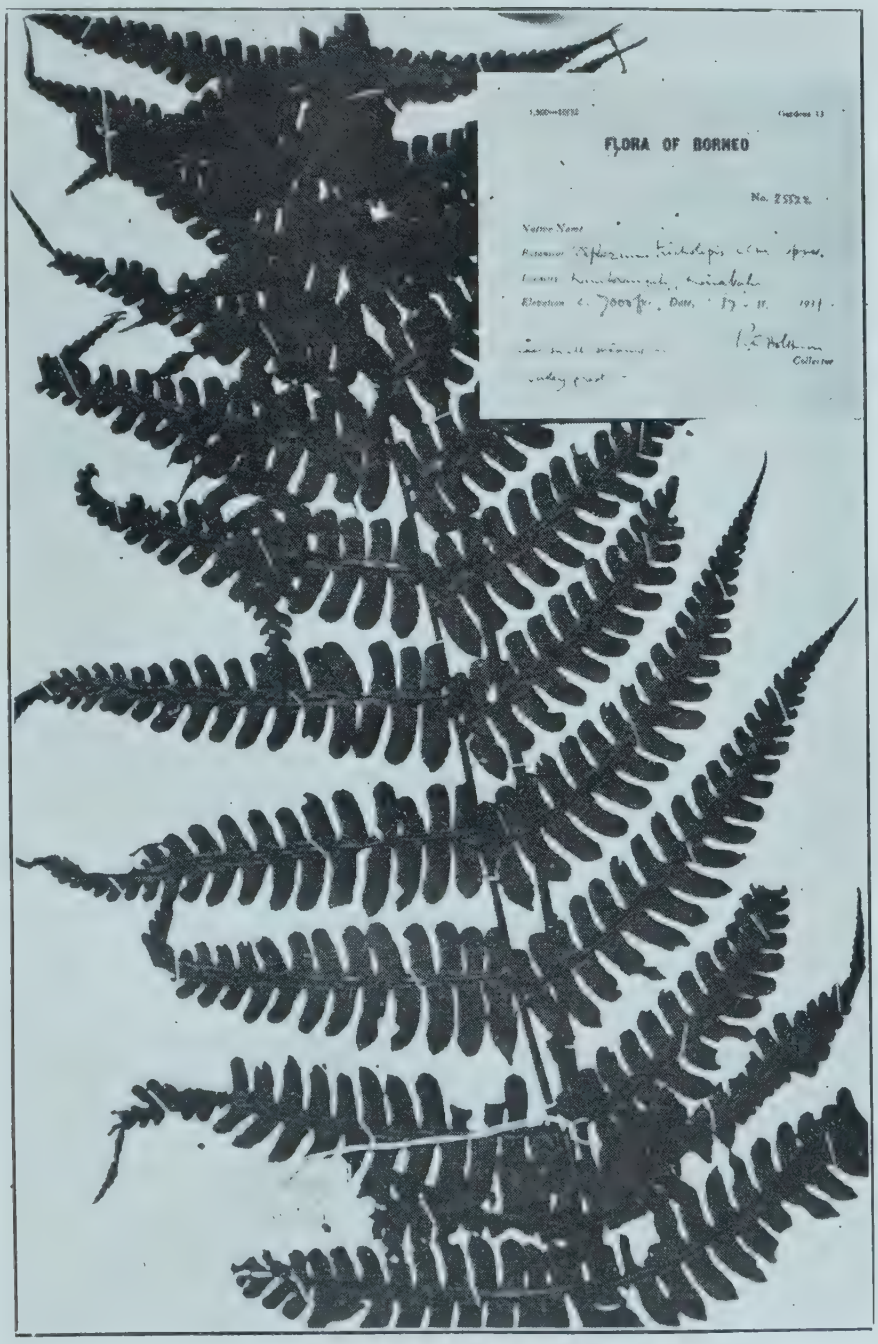


Polystichum gemmiparum C. Chr. H. 25561, × 1/3.

Tectaria Holttumii C. Chr. H. 27313, × 1/3.

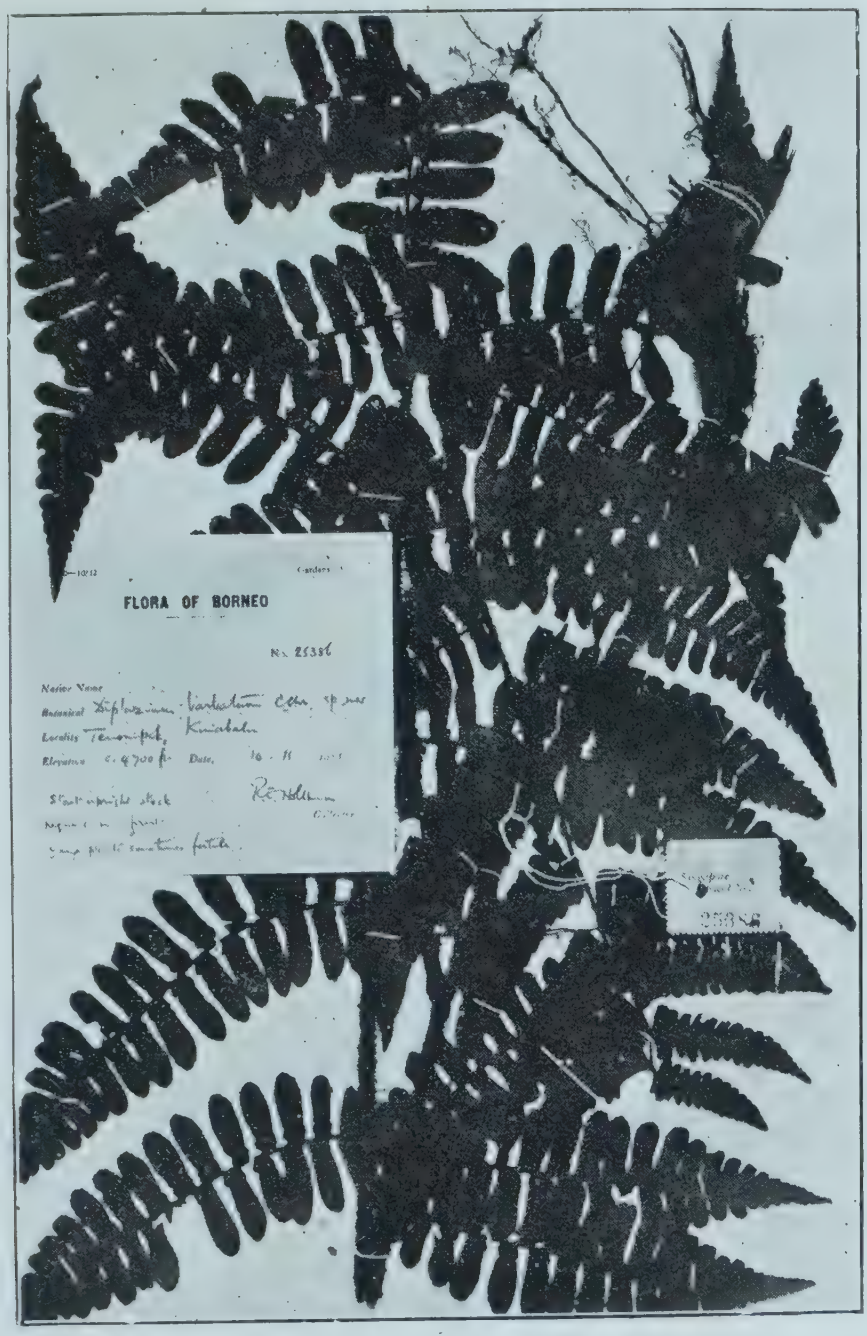


Athyrium amoenum C. Chr. H. 25530, × ½.

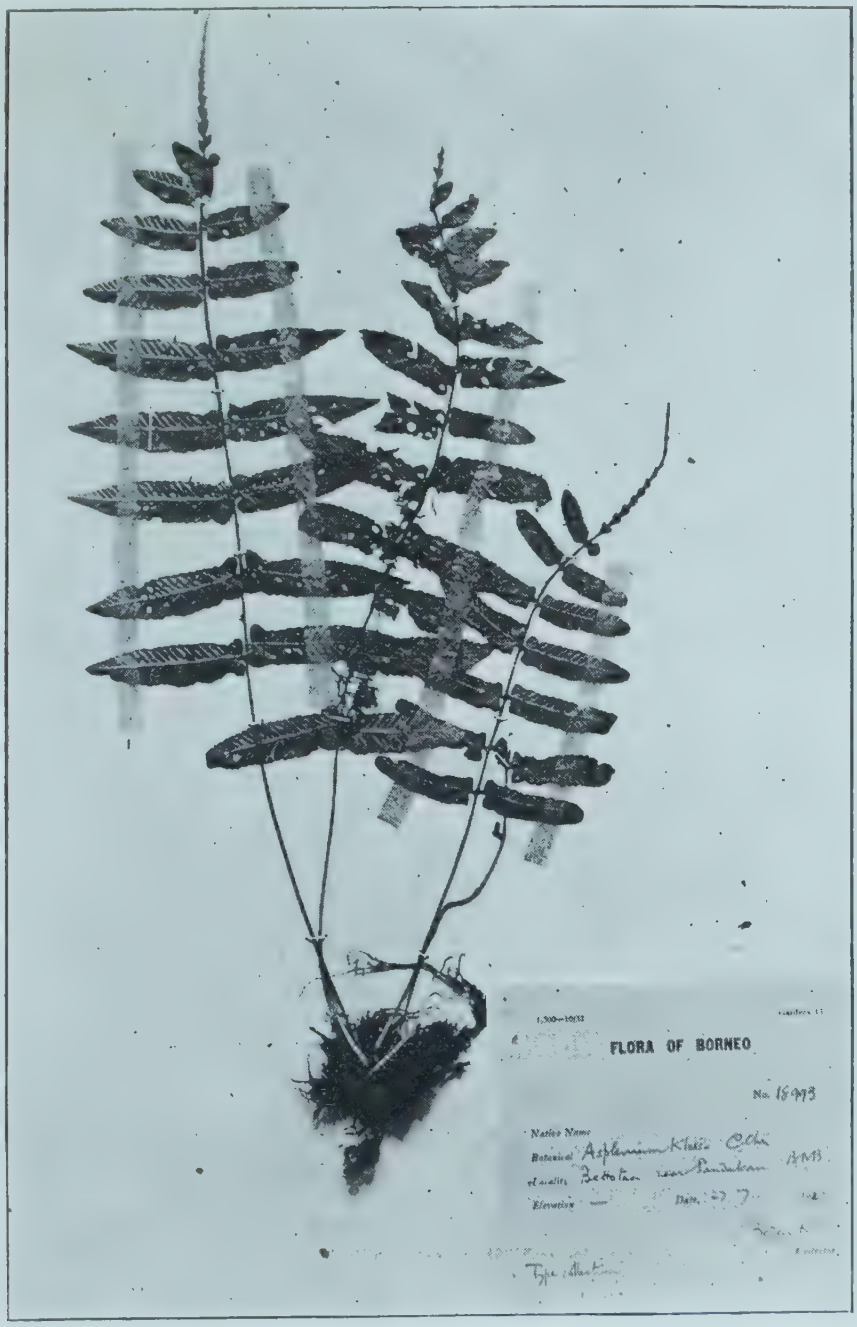


Diplazium tricholepis C. Chr. H. 25522, × 1/3.

Diplazium laevipes C. Chr. H. 25259, × 1/3.



Diplazium barbatum C. Chr. H. 25386, × 1/3.



Asplenium Klossü C. Chr. Kloss 18993, × 1/3.

Asplenium malayo-alpinum Holttum H. 25485, × 1/3.

Asplenium kinabaluense Holttum Cl. 29830, × ½.

DEPARTMENTAL NOTICES

A list of plants which can be purchased at the Botanic Gardens in Singapore and Penang can be had on application. The same list appears at intervals in the Government Gazette.

The Gardens' Bulletin is published at irregular intervals as material becomes available. The price of separate parts is fixed according to their size. The subscription in advance for the complete volume is $8 in the Malay Peninsula or £1 outside, post free.

Reproduction from it is not prohibited.

15823—600—5/34

THE

GARDENS' BULLETIN

SINGAPORE

Vol. XI 30th September, 1947 Part 4

CONTENTS

	PAGE
The Singapore Botanic Gardens during 1941–46 ..	263
Mr. J. C. Nauen, Obituary	266
New Species of Vascular Plants from the Malay Peninsula, *by R. E. Holttum*	267
New Species of Eugenia Linn. (Myrtaceae) *by M. R. Henderson*	299

To be purchased at the Botanic Gardens, Singapore.
Price $3.50 or 8*s.* 2*d.*

Published by Authority.

PRINTED AT THE GOVERNMENT PRINTING OFFICE, SINGAPORE,
BY V. C. G. GATRELL, GOVERNMENT PRINTER

1947

CHANGE OF TITLE

The Colony of the Straits Settlements has ceased to exist. The title of this Bulletin is now therefore changed, but the present issue is a direct continuation of the former Gardens' Bulletin, Straits Settlements, of which the last issue was Vol. XI, part 3, published 30 August 1941.

THE

GARDENS' BULLETIN

SINGAPORE

Vol. XI 30th September, 1947 Part 4

THE SINGAPORE BOTANIC GARDENS DURING 1941-46

Prior to the Japanese attack on Malaya, most of the senior staff of the Gardens were seconded for other duties under the Departments of Food Control and Information, for at least part of the time. The result was that botanical work was reduced, and considerable arrears of unnamed and undistributed specimens accumulated. The Gardens were maintained as usual, with the addition of demonstration plots of vegetables.

After the attack on Malaya, Messrs J. C. Nauen (in charge of the Waterfall Gardens, Penang) and G. H. Addison, horticultural officers, were mobilized with the local defence forces; they were subsequently taken prisoner and sent to work on the Siam-Burma railway, where Mr. Nauen lost his life. An appreciation of Mr. Nauen's services is given elsewhere in this issue. Mr. J. L. Pestana, Laboratory Assistant, was similarly taken prisoner and sent to Siam. Mr. J. W. Ewart, the third senior horticultural officer, was on leave, and was later transferred temporarily to the Dept. of Agriculture, Gold Coast. Mr. M. R. Henderson, Curator of the Herbarium, was evacuated from Singapore with the Dept. of Information, and subsequently worked in the herbarium of the National Botanic Gardens, Kirstenbosch, South Africa. Messrs R. E. Holttum and E. J. H. Corner remained in Singapore during the Japanese occupation; also Dr. C. X. Furtado, Assistant Botanist.

At the time of the Japanese attack on Singapore, fighting ceased on a line about half a mile from the Gardens boundary. Part of the Gardens was occupied by defending troops; and a considerable number of small shells were fired by the Japanese into the Gardens. Most of these exploded in tree-tops, and caused some casualties later among the trees. A few small trees were damaged owing to the digging of trenches and other operations, but on the whole the woody plants of the Gardens suffered little serious damage. The Director's house had a direct hit from a shell, and the Gardens Store was slightly damaged by a

bomb which exploded 20 yards away. The offices and herbarium were undamaged. The local Gardens staff nearly all remained at their quarters, where they had good shelters; three or four of them suffered minor injuries.

Three days after the Japanese occupation, Professor Hidezo Tanakadate, of Tohoku Imperial University, assumed control of the Gardens. He asked Mr. Holttum to remain in executive charge, and to resume all normal horticultural work. The Japanese military required the supply of some ornamental plants, but only such as were easily propagated. Professor Tanakadate and his successors took energetic steps to see that the Gardens were not in any way despoiled by the Japanese military; and the same action was also taken with regard to the Nature Reserves in Singapore Island under the control of the Gardens. Prof. Tanakadate arranged for the Botanic Gardens and Raffles Museum to form a single Department under the Municipality of Singapore, with head office at the Museum. In Sept. 1942 the Marquis Yoshichika Tokugawa assumed the office of Honorary President of the Museum and Gardens; this he held until his departure for Japan in the middle of 1944.

In December 1942 Professor Kwan Koriba, Professor of Botany at the Imperial University of Kyoto, was appointed Director of the Gardens. Thereafter Mr. Holttum ceased to have responsibility for garden work, but unofficially both he and Mr. Corner remained in constant touch with the local staff and advised them in their work. Garden work continued throughout the Japanese occupation, but greatly deteriorated for various reasons. More than half the outdoor staff (49 men) were sent by the Japanese military to work in the Siam-Burma railway; some of those remaining were taken for planting experimental crops of medicinal, fibre and dye plants in the adjoining Tyersall estate, and latterly all spent part of their working time in food production; tools also were gradually reduced both in number and quality. Fortunately the motor mowers were maintained in good running order throughout, so that the grass of the main lawns never got out of hand. Many outlying parts of the Gardens were neglected and became overgrown, and there were considerable losses in some collections of smaller plants. Stocks of pot plants were greatly reduced.

Wages for local staff at the end of the Japanese occupation were less than double the wages of 1941, but prices gradually increased to about 500 times those of 1941, with the exception of a small and diminishing fixed-price ration of rice, sugar and oil. Municipal employees, including those of the Gardens, were at a great disadvantage as

compared with persons employed directly by the Japanese military; but most of the Gardens staff, both indoor and outdoor, remained at their work. Had they not done so, the Gardens could not have been maintained as they were, nor so quickly rehabilitated in 1946. In this connection, special credit is due to Mr. Quan Ah Gun, Chief Clerk, and to Dr. Furtado. Of the men who were sent to work on the Siam-Burma railway, twenty-two lost their lives. These included both Indians and Malays.

Prof. Koriba obtained permission for Messrs. Holttum and Corner to remain in the Gardens and continue their botanical work. Mr. Corner continued his researches on the larger fungi, and also made elaborate investigations of the development of flowers and fruits in various families of trees, from the appearance of the first floral rudiments to ripe fruits and seeds. Mr. Holttum spent most of his time preparing new descriptions of Malay Peninsula representatives of the following groups: Ferns, Orchidaceae, Zingiberaceae, Marantaceae, Gramineae, Cyperaceae.

The Herbarium remained intact (except for the loss of some specimens on loan in Germany) and also the library. All the Japanese scientific officers concerned were insistent that the Herbarium and library (as also the collections at the Raffles Museum) should be preserved as part of the cultural heritage of Malaya, and on this basis the British staff cooperated with them. We should like to express our gratitude to Professor Koriba and others concerned for the disinterested way in which they carried out their duties, and also for much personal courtesy and kindliness. Professor Koriba himself carried out a research into the growth-behaviour of some Malayan trees.

From September 1945 to March 1946, under the British Military Administration, the Gardens were under the care of Dr. Gilbert Archey (Director of the Auckland Museum, New Zealand), who was responsible for Monuments, Fine Arts and Archives. Mr. Holttum left for England on September 18th. Mr. Corner remained in Singapore in immediate charge of the Gardens until November 11th. Mr. J. W. Ewart returned soon afterwards and had charge of the Gardens until the return of Mr. M. R. Henderson in January 1946. Mr. Addison returned to take charge of horticultural work in April 1946, Mr. Ewart being appointed to undertake the duties of Agricultural Officer, Singapore. Mr. Holttum returned to duty as Director in May 1946.

Mr. J. C. Nauen

John Charles Nauen came to Singapore in July 1935 as an Assistant Curator of the Gardens. He had previously served seven years in Bermuda after completing his training as a Student Gardener at Kew. He remained in Singapore until July 1939, when he was placed in charge of the Waterfall Gardens, Penang. When the Japanese attacked Malaya in December 1941, Mr. Nauen was mobilized as Sergeant in the Penang Volunteer Force, and as such was taken prisoner in Singapore in February 1942. He was subsequently sent to work on the Siam-Burma railway, where he died as a result of blood poisoning in October 1943.

Mr. Nauen was an officer of outstanding ability; and as a man he was held in affection and esteem by all who knew him. He had a very wide knowledge of garden plants and their management, excellent judgment in their use and arrangement, and a great gift in garden design. He devoted much thought to his administrative work and to the welfare and training of those who worked under him. He helped considerably to raise the standard of horticultural work in the Gardens both at Singapore and Penang. He devoted much time and thought to the roadside trees of Singapore. He helped to found a Gardening Society in Singapore, and did good service as its first Secretary. He was the leading spirit in the organization of the Society's Flower Shows, which were a stimulus to professional and amateur growers alike. His alert mind, his sense of humour, his human sympathy, and his integrity of purpose are the characters by which we remember him. His untimely death is a great loss to Malaya.

NEW SPECIES OF VASCULAR PLANTS FROM THE MALAY PENINSULA

By R. E. Holttum

During a survey of the ferns, orchids, grasses and Cyperaceae of the Malay Peninsula, based on all specimens in the Singapore herbarium, a number of undescribed species were found. These are described below. It is hoped that full revised accounts of all these families, as represented in the Malay Peninsula, will be published later. Various changes of names, found necessary during the work, are also here published.

FILICALES

Schizaea paucijuga Holtt., sp. nov.

Rhizoma parvum, apice pilis tenuibus brunneis c. 1½ mm. longis vestitum; *frondes* simplices, c. 8–20 cm. longae, basi teretae, supra basin sensim in laminam angustissimam costatam transientes, haud 1 mm. latae, apice 2–5 lobos fertiles 7–15 mm. longos ferentes; *lobi fertiles* margine glabri, sporangia biseriata pilis brunneis intermixta ferentes.

Typus: Kedah Peak, alt. 3000 ped., S.F.N. 1098, leg. Md. Haniff.

This plant has the aspect of a small *S. digitata*, with a distinctly costate but very narrow blade, and the fertile lobes apparently digitately arranged. The lobes are also very like those of *S. digitata* in appearance, but they have only two rows of sporangia and the sporangia are accompanied by hairs as in *S. dichotoma*. It is thus somewhat intermediate between *S. digitata* and *S. dichotoma* (nearer the latter) but has fronds no wider than those of *S. malaccana*. It has the rhizome-hairs of *D. digitata*.

Phymatodes subfasciata Holtt., sp. nov.

Rhizoma breve, c. 2 mm. diametro, frondes confertas ferens; *paleae* haud 3 mm. longae, basi haud 1 mm. latae, margines pilis brevibus paucis instructae, tenues, rufo-brunneae. *Stipites* haud basi anguste decurrente frondis distincti, ad summum 2 cm. longi. *Frondes* tenuiter coriaceae, ad 20 cm. longae et 12 latae, oblanceolatae, apice obtusae vel rotundatae, margine manifeste serrulatae, dentes 3–4 mm. dissiti, venae obscurae. *Sori* in seriebus irregularibus 1–4 inter costam et marginem dispositi, sori bini in serie quoque inter venas adjacentes, non immersi, parvi sed interdum contigui; *frondes steriles* fertilibus similes, paucae.

TYPUS: Fraser's Hill, S.F.N. 21559, leg. Holttum.

This species is near *Polypodium subsparsum* Baker (Sumatra) but differs in the much closer hardly stalked fronds, the much more distinctly toothed edges, and smaller sori in more series on larger fronds.

Grammitis crispatula Holtt., sp. nov.

Paleae rhizomatis angustae, acutae, 2 mm. longae, pallide brunneae, integrae. *Stipites* c. 1 cm. longi, pilis rufis confertis patentibus ½ mm. longis vestiti. *Frondes* tenues, 4–10 cm. longae, 6–8 mm. latae, basi abrupte angustatae, apicem versus sensim angustatae, apice obtusae, marginibus omnino crispatulis, utroque latere pilis brevissimis patentibus vestitae. *Venae* unifurcatae, rami inaequales, ramus acroscopicus brevior, cum costa parallelus, ramus basiscopicus longior, patens, marginem non attingens; *sori* ramos acroscopicos venarum occupantes, prope costam, non contigui.

TYPUS: Perak, Maxwell's Hill, 3300 ped. alt., S.F.N. 12705, leg. Burkill, 6 March 1924.

This species is characterized by its short hairs and simple basal vein-branch.

Ctenopteris sparsipilosa Holtt., sp. nov.

Rhizoma breve, erectum, frondes fasciculatas ferens; *paleae* angustae integrae, pallide brunneae, ad 4 mm. longae. *Frondes* brevissime stipitatae, 7–15 cm. longae, 4–7 mm. latae, apicem et basin versus sensim angustatae, dimidio costam versus pinnatifidae, costa pilis brevibus adspersis pallidis (vel rufis ?) instructa; lobi laminae basi 2–2½ mm. lati, obtuse triangulares vel semi-elliptici, integri; *venae* unifurcatae; *sori* in ramis acroscopicis venarum positi, elliptici (receptaculum elongatum), leviter immersi, sporangia nuda.

TYPUS: Gunong Brinchang, alt. 6000 ped., S.F.N. 23522, leg. Holttum.

Near *Polypodium subpinnatifidum* Bl. of Java, Sumatra and Borneo, differing in the absence of spreading hairs on the frond, in broader fronds, with the lower edges of the lobes never revolute, distinctly elongate sori and non-setose sporangia.

Thelypteris herbacea Holtt., sp. nov.

Caudex brevis, erectus. *Stipites* fasciculati, ad 30 cm. longi, tenues, basi excepta pallidi, ex toto capillis mollis pallidis brevibus vestiti; *squamae* breves, angustae, fere nigrae, mox deciduae, raro in frondibus adultis persistentes. *Lamina* fere ad 35 cm. longa et 13 cm. lata, pinnae liberae fere 15-jugatae, inter se distantes c. 2.5 cm., infimae

deflexae sed non reductae; *pinnae maximae* c. 7 cm. longae et 13 mm. latae, acuminatae, sessiles, margine 3/4 ad costam lobatae; *lobi* oblongi, obtusi, integri, 2·5–3 mm. lati; lobus infimus acroscopicus leviter elongatus et interdum ad costam incisus; textura laminae tenuis, herbacea; color in sicco pallide olivaceus; *rachis* straminea, supra dense pilis brevibus, infra pilis patentibus pallidis paucioribus vestitae; *costae* supra pilis crassulis pallidis appressis vestitae, pili similes super venas et margines adspersi; costae infra pilis brevioribus, tenuioribus, patentibus, pallidis vestitae; pili pauci similes venas adspersi; glandulae nullae. *Venulae* in lobis simplicis, 4–5–jugatae, pallidae, utrinque distincte elevatae; sori in medio venarum aut leviter infra medium; indusia reniformia, brunnea, persistentia, pilis rigidis pallidis paucis instructa.

TYPUS: G. Tahan, S. Reriang, alt. 3000–3500 ped., S.F.N. 20571, leg. Holttum. Also G. Tahan, Wray's Camp, Ridley 16212; G. Padang (Trengganu), 4000 ft., Moysey s.n. 26.6.1937.

This is most nearly related to *Dryopteris pectiniformis* C. Chr. but differs in the scales on the stipe being smaller, darker and not persistent, the pinnae smaller but with broader blunt segments, the surfaces not glandular. It is possible however that *T. herbacea* may exist in two varieties, one with glands and one without, like *D. pectiniformis*. *T. herbacea* differs from *D. viscosa* (J. Sm.) C. Chr. in the pale stipes and rachis, deciduous scales, thinner texture of the lamina and absence of superficial yellow glands.

Cyclosorus ecallosus Holtt., sp. nov.

Caudex brevis repens; *stipites* fasciculati, basin versus squamulis angustis brunneis vestiti, cetera glabri, ad 100 cm. longi. *Lamina* 100 cm. longa et ultra, 45 cm. lata. *Pinnae* multijugatae, sessiles; pinnae infimae 2– vel 3–jugatae haud 2 cm. longae, basi acroscopica valde auriculatae; pinnae subbasales basin versus leviter angustatae, basi acroscopica auriculatae (auriculae magnae, lobatae); pinnae mediales et superiores basi truncatae vel late cuneatae, maximae c. 28 cm. longae et 2·5 cm. latae, apice longe acuminatae, margine dimidio costam versus incisae; *lobi* fere recti, patentes, truncati, apicem versus leviter dentati, basi c. 5 mm. lati; textura laminae tenuis, in sicco subtus verruculosa; rachis et costae supra hirsutae, lamina cetera glabra; *venulae* 7–10–jugatae, subtus pallidae et valde prominentes, infimae solum anastomosantes, vena excurrens recta, ad basin membranae sinus terminata; venulae sub-basales latera membranae attingentes, ceterae ad marginem liberam lobi terminatae; sori inframediales,

in ordinibus duobus cum costulis parallelis; indusia persistentia, integra.

TYPUS: Pahang, Cameron Highlands, alt. 5000 ped., S.F.N. 31294, leg. Holttum. Also same locality, S.F.N. 23427, leg. Holttum. This is closely allied to *C. truncatus* (Poir.) Farw., agreeing in texture and verrucose character of the lamina, in the sori arranged in two parallel rows near the costules, and in pubescence. It differs in having the few lower pinnae prominently auricled on the upper base, with 2 or 3 pairs of greatly reduced pinnae below them, and no small auricles on the stipe, and in having only one pair of veins truly anastomosing, the next pair meeting the sides of the sinus-membrane which is somewhat longer than in *C. truncatus*.

Elaphoglossum peninsulare Holtt., sp. nov.

Rhizoma breve, c. 5 mm. diam.; *paleae* fusco-brunneae, angustae, acuminatae, marginibus irregulariter dentatis vel lobatis. *Stipites* frondium sterilium supra articulationem nulli, infra articulationem 10–15 mm. longi; stipites frondium fertilium 7–15 cm. longi, in juventute dense paleacei. *Frondes steriles* coriaceae, ad 40 cm. longae et 6.5 cm. latae, oblanceolatae, basin versus sensim angustatae, apice obtusae, margine non cartilagineae, infra in juventute paleaceae, paleae costales eis rhizomatis similes sed minores, paleae paginae minutae, stellatae, multiradiatae. *Frondes fertiles* quam sterilibus breviores, 1·7–3·7 cm. latae.

TYPUS: Patani (Lower Siam), Betong, Ban Chanaka, 210–350 m. alt., leg. Eryl Smith 2021, 9 August 1923. Also: Penang Hill 2000 ft., Holttum s.n. 6.1.1937; Richmond Pool, Ridley s.n. 1898. Pahang, Tahan River, Ridley s.n. 1891.

This species grows with *E. melanostictum* (Bl.) Moore on Penang Hill and is rarely fertile. It is easily distinguishable from *E. melanostictum* by its broader fronds, more abruptly narrowed to the bluntly pointed apex, and in its thicker texture. The scales on the lower surface are also more conspicuously stellate, and the fertile fronds very much wider than those of *E. melanostictum* (which are only .1 cm. wide).

Elaphoglossum brevifolium Holtt., sp. nov.

Rhizoma paleaceum ei *E. callifolii* simile; *stipites* frondium sterilium 4–12 cm. longi, frondium fertilium 20–25 cm. longi, infra laminam anguste alati, in juventute paleacei, paleae partim eis rhizomatis similes, partim parvulae irregulares. *Frondes steriles* crasse carnosae, 8–12 cm. longae, 3·5–6 cm. latae, basi anguste cuneatae, apice obtusae, marginibus ½ mm. latis pellucidis, frondes juveniles infra paleis minutis irregulariter stellatis adspersis instructae. *Frondes fertiles* 8–10 cm. longae, 2–3 cm. latae.

TYPUS: Pahang, G. Tahan, alt. 4500 ped., S.F.N. 20750, leg. Holttum, 2 September 1928.

This species has been found on G. Tahan by two other collectors, and a small specimen also on G. Batu Puteh (Main Range, Perak) at 4500–6000 ft. The short broad blunt fleshy fronds with very conspicuous cartilaginous edge, and the very long stipes of the fertile fronds are characteristic.

Bolbitis singaporensis Holtt., sp. nov.

B. quoyanae affinis, differt: pinnis crenatis vel paululo lobatis, basi antice late cuneatis plerumque auriculatis, postice angustioribus, rotundatis; venulis areolas costales et costulares formantibus, areolis ceteris paucis, interdum nullis; costulis maxime 6 mm. dissitis.

Rhizome creeping, the apex bearing thin narrow dull brown scales c. 5 mm. long. *Stipes* close together, green when living, pale when dry, bearing scattered scales throughout, to about 25 cm. long in sterile and 40 cm. in fertile fronds. Lamina of *sterile frond* to about 45 cm. long and 20 cm. wide, pinnae about 12 pairs below the narrowly deltoid lobed pinnatifid apical portion; lowest pinnae slightly shorter than those next above, hardly stalked, subequally cuneate at the base; remaining pinnae to about 13 by 2·5 cm., subtruncate or broadly cuneate and usually slightly auricled on the anterior base, rather narrowly rounded on the posterior side, the margins crenate or shallowly lobed, the crenations or lobes entire except for a single (usually small) tooth often present in the sinuses; texture firm-herbaceous, drying rather dark olivaceous, the smaller veins not clearly raised on either surface; costules 5–6 mm. apart, at about 60° to the costa, straight; veins forming a regular series of costal areoles and usually a few costular areoles, with at most one other series of areoles between those of adjacent costules; in the distal part of some pinnae all veins free except for the costal areoles. *Fertile fronds* with about 10 pairs of pinnae, pinnae to about 6·5 cm. long and 8 mm. wide, the margins entire or crenate, the apex blunt, veins as in the sterile fronds but much closer together, bearing sporangia throughout, the sporangia filling the whole lower surface at maturity.

TYPE: Bukit Timah, Singapore, Hullett s.n., March 1882 (2 sheets).

This is intermediate between *Bolbitis quoyana* and *Egenolfia appendiculata*. It has only been collected in one valley on Bukit Timah, where both these species grow, on granite rocks in the stream bed.

Dryopteris (§ Polystichopsis) **Haniffii** Holtt., sp. nov. **Fig. 1.**

Caudex brevis terrestris. *Stipites* fasciculati, ad 70 cm. longi, dimidio basin versus squamulis angustis integris castaneis vel fuscis, ad 15 mm. longis et 1½ mm. latis dense vestiti, squamae in dimidio superiore breviores, angustiores, fusciores, in frondibus senescentibus plerumque deciduae. *Lamina* ad 55 cm. longa et 40 cm. lata, copiose tripinnata, basi quadripinnata, deltoidea; pinnae infimae maximae, pinnulae earum basiscopicae infimae quam sequentibus haud longiores. *Pinnae infimae* ad 22 cm. longae et 9 cm. latae, pinnulae maximae ad 6 cm. longae et 2 cm. latae, foliolae ordinis tertii ad 2 cm. longae et 6 mm. latae, foliolae ordinis

Fig. 1. **Dryopteris Haniffii**: a pinnule and a tertiary leaflet

quarti, lobique maximi pinnarum superiorum, ad 8 mm. longae et 2 mm. latae; foliolae vel lobi ultimi acuti, apice dentibus 1–3 brevibus rigidis instructae. Textura laminae subcoriacea; color supra in vivo atroviridis, nitens, in sicco atro-olivaceus; rachides, costae, laminaque squamulis angustissimis (plerumque filiformibus) adspersis vestiti. *Venae* in foliolis pinnatae, venulae furcatae (interdum bis furcatae); *sori* in ramulis acroscopicis sedentes, terminales; indusia non visa.

TYPUS: Pahang, Cameron Highlands, Brinchang, alt. 5000 ped., S.F.N. 31286, leg. Holttum. Also G. Kerbau, alt. 6000 ft., leg. Haniff no. 4038.

This beautiful species is evidently allied to *Aspidium carvifolium* Kze., but differs in its much more finely dissected condition, with very narrow leaflets. It was first collected in 1909 by the late Mohamed Haniff, Overseer of the Waterfall Gardens, Penang, and I name it to perpetuate his memory as a discriminating collector of ferns, and as a keen field botanist from whom I learnt much.

Athyrium angustisquamatum Holtt., sp. nov.

Rhizoma erectum, apice squamis linearibus ad 2 cm. longis haud ½ mm. latis brunneis nitidis leviter undulatis apicem versus dentatis dense vestitum. *Stipites* c. 45 cm. longi, basin versus nigrescentes, apicem versus in vivo virides, basin versus squamulis angustis dense vestiti, supra basin sparse squamati. *Lamina* bipinnata-tripinnatifida, c. 85 cm. longa et 70 cm. lata; pinnae infimae 30 cm. longae, stipitibus 5 cm. longis instructi; pinnae maximae 40 cm. longae et 16 cm. latae, stipitibus 2·5 cm. longis instructi; pinnulae plerumque alternae, pinnulae liberae c. 16-jugatae, infimae leviter reductae, maximae c. 9 cm. longae et 2·4 cm. latae, subsessiles, basi fere aequaliter truncatae (superiores late cuneatae), apice breviter acuminatae, dentatae, margine 4/5 costulam versus lobatae; lobi leviter obliqui, c. 5 mm. lati, apice truncati vel rotundati, subintegri vel leviter crenatoserrati, sinubus angustis separati; rachides, costae, costulae, venaeque subtus squamulis angustis pallidis valde dentatis adspersis instructae, pagina supra glabra; textura laminae herbacea, color in sicco olivaceus; *venae* in lobis ad 7–jugatae, simplices, rarissime furcatae, obliquae; *sori* minuti, ad basin venarum sedentes, rotundati; receptaculum leviter elevatum; indusium non visum.

TYPUS: Selangor, Ginting Simpak, alt. 2500 ped., S.F.N. 37359 leg. Holttum.

This species has the aspect of a bipinnate species such as *A. latisquamatum* Holtt. or *A. procumbens* Holtt., but

differs most strikingly in the long very narrow medium brown shining scales, and in the very small sori. Only one fertile frond was found, and the sori are rather old.

Taenitis dimorpha Holtt., sp. nov.

Frondes steriles semper simplices, lamina ad 40 cm. longa et 4·5 cm. lata, stipites plerumque 10–20 cm. longi; *frondes fertiles* longe stipitatae, plerumque trifoliatas vel pinnatae, pinnae ad 4–jugatae, plerumque 20–30 cm. longae et 8–10 mm. latae.

TYPUS: G. Muntahak, Johore, alt. 2000 ped., S.F.N. 17399, leg. Holttum.

This species is closely allied to the variable *T. blechnoides*, but the latter always has pinnate sterile fronds on well grown plants, and there is never such a difference in width between fertile and sterile fronds. *T. dimorpha* has been found at several localities in Johore, Malacca, Selangor and Pahang, and seems quite distinct; but it grows in the same places as *T. blechnoides* and the two should be compared in the field.

Vittaria angustissima Holtt., sp. nov.

Rhizoma breve, repens, paleis 2–3 mm. longis integris anguste acuminatis dense vestitum. *Frondes* confertae, 3–9 cm. longae et 1 mm. latae, basin versus sensim angustatae; costa supra leviter caniculata, infra plana; *sori* interdum unilaterales, interdum bilaterales, fere apicem et basin frondis attingentes, submarginales, profunde immersi; cellulae extremae paraphysium obovoideae latitudine longitudine aequales.

TYPUS: Pahang, Fraser's Hill, alt. 4000 ped., leg. C. E. Carr, March 1929. Also same locality, S.F.N. 8835, Burkill & Holttum.

This species is evidently allied to *V. parvula* Bory (*V. lloydiifolia* Racib.) of Java, but is even smaller, and differs in its smaller hair-pointed scales and in the fact that many fronds have sori on one edge of the lamina only. In the fronds which have one sorus only, the non-soriferous half of the lamina is evenly attenuated to the thin margin; where both edges are fertile, the appearance is much as in *V. angustifolia* Bl., the middle area between the sori almost flat on the lower surface, distinctly narrower than the full width of the frond, its edges raised somewhat when the sorus is fully mature with many ripe sporangia.

ORCHIDACEAE

Acriopsis Carrii Holtt., sp. nov.

A. javanica affinis, differt: foliis ad 30 cm. longis et 1 cm. latis; inflorescentia ad 40 cm. longa, ramis pluribus (ad 12), rigide patentibus, brevioribus (5–12 cm. longis); floribus immaculatis; labello albo, gynostemium viride, cucullo brachiaque albescentibus; sepalis petalisque pallide flavescentibus; lamina labelli 3½ mm. longa, basin 1½ mm. lata, supra basin fere ad 1 mm. angustata, apice reflexa, emarginata, carinis 1½ mm. longis.

TYPUS: Gua Musang, Kelantan, 400 ft., leg. C. E. Carr, no. 135.

Also collected at Gua Musang by Henderson, by the Sungei Galas, on *Platycerium Ridleyi* (fern), epiphytic on a Dipterocarpus tree by the river (S.F.N. 22623); also at Bator, Kelantan by Haniff & Nur (S.F.N. 12054).

Anoectochilus duplex Holtt., sp. nov.

Herba c. 10 cm. alta; lamina folii ad 3·5 cm. longa, 2·1 cm. lata, ovata, brevissime acuta, viridis, petiolus cum vagina ad 2 cm. longus; scapus brevissimus; rachis brevis, pubescens, 3–5 flores ferens; bracteae pilis longis adspersis vestitae, ad 11 mm. longae, quam ovarium breviores; *sepalum dorsale* 5 mm. longum, late ovatum, obtusum; *petala* tenuia, sepalo dorsali agglutinata; *sepala lateralia* basi valde concava, basin labelli amplectentia, 9 mm. longa; *labellum* 12 mm. longum, in basi saccata medio carinatum, utrinque glandulis duabus instructum; lobi laterales nulli; unguis angusta, marginibus inflexis contiguis, extus utrinque lamellam dupliciter pectinatam ferens, dentes ordinis primi 4, 2–3 mm. longae, ordinis secundi minores; lamella extrema labelli bilobata, lobi 6½ mm. longi, 4 mm. lati; *gynostemium* 4½ mm. altum, rostello lato incluso, facie inferiore prope stigmata alis duobus parvis triangularibus instructum.

TYPUS: Semangkok Pass, leg. W. S. Napier, February 1904.

Also collected at Fraser's Hill by Burkill & Holttum (F.D. 7803); flowers greenish, blade of lip white. Differs from all other known species of Anoectochilus in the double row of teeth on the flange of the claw of the lip, and also from other Peninsula species in the short upper sepal.

Ascocentrum micranthum (Lindl.) Holtt., comb. nov.

Basinym: *Saccolabium micranthum* Lindl., Gen. et Sp. Orch. 220. 1833.

Synonyms: *Cleisostoma micranthum* King & Pantl., Ann. Calc. 8: 234, pl. 312. 1898.
Saccolabium fissum Ridl., J. Linn. Soc. 32: 361. 1896.

There is a drawing of Ridley's species at Singapore, and I have examined the type specimen. I cannot see that it differs from Pantling's drawing. It does not belong to the genus Cleisostoma (now called Pomatocalpa), having no appendage in the back of the lip. If the flowers were much enlarged, the species would be placed in the genus Vanda. I am not sure that it is properly placed in Ascocentrum, but can find no other genus for it.

Bulbophyllum (§ Micromonanthe) **nigromaculatum** Holtt., sp. nov. **Fig. 2.**

B. tenuifolio Lindl. affinis, differt: pseudobulbis majoribus (1·5 cm. longis) non angulatis; sepalis multo longioribus (9–10 mm. longis), sepalis lateralibus obscure purpureo-striatis, sepalo dorsale venulis 3 viridibus instructo; petalis margine maculis nigris 3 ornatis; labello majore (7 mm. longo), basin versus atropurpureo, basi infra papilloso.

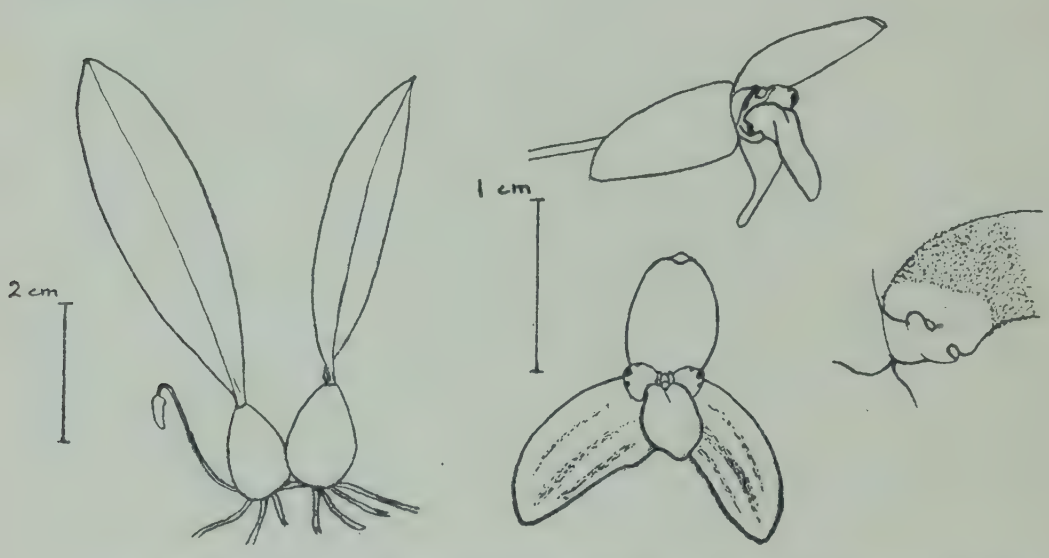


Fig. 2. **Bulbophyllum nigromaculatum:** plant; flower in face and oblique view; base of lip from below.

Pseudobulbs almost touching, ovoid, to 1·5 cm. long, flushed with purple; leaf to 6 by 1·5 cm., hardly stalked, base flushed with purple; scape 2 cm. long, pedicel 3·5 cm.; *sepals* pale green, laterals slightly flushed with purple along the veins, upper with 3 green veins, all 9–10 mm. long, 4½–5 mm. wide, abruptly short-pointed; *petals* 3 mm. long, nearly circular, pale yellow with apical black spot and a smaller one on each side of it; lip bent at right angles close to the base, 7 mm. long, 3 mm. wide, tongue-shaped, base dark purplish with a yellow median groove, apex

yellow with purple spots, lower surface purple, papillose near base; *column* green, anther with arms on each side of it yellow, arms as tall as anther; column-foot flushed with purple, with a free curved end bearing the lip.

TYPE: Cameron Highlands, 4800 ft. alt., leg. Holttum, August 1946.

Calanthe cleistogama Holtt., sp. nov.

Folia ignota; flores non aperti; *sepala* viridi-flavescentia, c. 8 mm. longa, 3½ mm. lata, brevissime mucronata; *petala* similia, flavescentia, leviter breviores; labellum flavum, 9 mm. longum, calcare incluso; calcar 2·5 mm. longum; lamina labelli 4 mm. longa, integra, valde concava, apice marginibus elevatis, 3½ mm. lata, breviter acuta; *gynostemium* album.

TYPUS: Fraser's Hill, leg. C. E. Carr.

The above description is based on flowers in alcohol and colour notes made by the collector. The only other Malayan species of Calanthe with flowers of comparable size is *C. Foerstermannii.*

Calanthe johorensis Holtt., sp. nov.

Folii lamina ad 70 cm. longa, 8 cm. lata, petiolus cum vagina c. 20 cm. longus; scapus c. 80 cm. longus, rachis ad 30 cm., multiflora; bracteae c. 2·5 cm. longae, caducae; pedicellus cum ovario c. 1 cm. longus; *flores* albi; *sepala* 1 cm. longa, 5 mm. lata, breviter acuta, *petala* 4 mm. lata, oblonga, obtusa; calcar labelli 11 mm. longum, rectum, clavatum, angulum 30° cum ovario faciens; lamina labelli trilobata, lobi laterales parvi, auriculiformes, ad basin laminae positi, lobus intermedius oblongus, c. 4½ mm. longus et 2½ mm. latus, basin versus costis 3 haud elevatis instructus, apicem versus reflexus, leviter concavus, apice bilobus, lobi rotundati, ½ mm. longi.

TYPUS: Johore, G. Panti, leg. C. E. Carr, November 1932.

The very long inflorescence of pure white flowers is distinctive among Peninsula species of Calanthe with caducous bracts.

Camarotis adnata (Ridl.) Holtt., comb. nov.

Basinym: *Sarcochilus adnatus* Ridl., J. Linn. Soc. 32: 373. 1896.

Synonym: *Saccolabium adnatum* Ridl., Flora Mal. Pen. 4: 174. 1924.

I have examined the type specimen; it is undoubtedly a Camarotis, and distinct from all other species known to me.

Coelogyne (§ Longifoliae) **stipitibulbum** Holtt., sp. nov.

Pseudobulbi 2–3 cm. dissiti, ad 6 cm. longi, 2¼ cm. lati, basi stipitiformes, supra medium dilatati, obtuse 4–angulati, demum longitudinaliter corrugati; *folia* 2, ad 15 cm. longa et 3 cm. lata, basi in petiolum 2 cm. longum angustata, margine crispata; scapus 6–10 cm. longus, compressus, 2–2½ mm. latus, rachis demum 30 cm. vel ultra longa, internodia c. 10 mm. longa, bracteae 2·5–2·8 cm. longae; *flores* omnino pallide salmonei; *sepàlum dorsale* 2·6–2·9 cm. longum, 10 mm. latum; *petala* 2 mm. lata; labellum 2·3 cm. longum, lobi laterales erecti, antice breviter rotundati, quam lobo intermedio multo breviores, lobus intermedius 1·5 cm. longus, 8 mm. latus, leviter convexus, anguste elllipticus, apice acutus, carinis duabus levibus humilibus usque ad dimidium lobi extensis instructus; *gynostemium* quam lobis lateralibus labelli brevius, apice late alatum, truncatum.

TYPE: Cameron Highlands, S.F.N. 23284, leg. Holttum & Henderson.

This species is closely allied to *C. carnea*, but differs in stalked pseudobulbs thickened in the upper half, larger flowers with differently shaped midlobe and proportionately shorter sidelobes and column.

Corybas caudatus Holtt., sp. nov.

Folia cordata, acuta, c. 18 mm. longa et 12 mm. lata, pallide viridia, margine non crispata; flos c. 2 cm. alta, ovario 4 mm. longo incluso; *sepalum dorsale* album, rubrostriatum, basi erectum, 3 mm. latum, apicem versus horizontale, leviter cucullatum, 7 mm. latum, apice rotundatum, in caudam 3–4 mm. longam abrupte productum, margine prope caudam leviter irregulariter dentatum; *sepala lateralia* petalaque rubra, basin versus alba, 3–3·5 cm. longa; *labellum* album, rubrostriatum, basi erectum, marginibus cucullum sepali dorsalis fere attingens, medio abrupte recurvum, margine alba fimbriata fere circulum formante, 15 mm. latum, fimbriae ad 2½ mm. longae; calcaria 4 mm. longa, supra rubra.

TYPUS: G. Tahan, leg. E. J. H. Corner, 1937.

This species is similar to *C. pictus* in its long lateral sepals and petal, but differs in (1) leaf not crisped, (2) caudate apex of dorsal sepal, (3) longer fringe on the lip.

Cystopus macranthus (Hk. fil.) Holtt., comb. nov.

Basinym: *Odontochilus macranthus* Hk. f., F.B.I. **6**: 98. 1890. Ic. Pl., t. 2161.

Synonym: *Anoectochilus macranthus* Ridl., Mat. Fl. M.P. **1**: 215. 1907.

As pointed out by Ridley, this species is a true Cystopus, which genus is maintained by J. J. Smith, being distinguished from Anoectochilus by having the two stigmas united. *C. macranthus* differs from most species of Cystopus by lacking a toothed flange on either side of the claw of the lip.

Cystorchis gracilis (Hk. f.) Holtt., comb. nov.

Basinym: *Goodyera gracilis* Hk. f., F.B.I. **6**: 112. 1890. Ic. Pl. t. 2183.

In typical Cystorchis the spur of the lip has a vesicle on each side at the base, each vesicle containing a gland. In *C. gracilis*, the spur is not elongated beyond the vesicles, which coalesce, giving a saccate structure containing two glands, as in *C. aberrans* J.J.S. (Bull. Buitenz. Ser. 3, **5**: 22. 1922), which may be conspecific with *C. gracilis*. Otherwise the flowers are like Cystorchis, not like Goodyera, which has hairs in the base of the lip.

Dendrobium (§ Calcarifera) **brinchangensis** Holtt., sp. nov. **Fig. 3.**

Pseudobulbi ad 70 cm. longi, internodia 2–2½ cm. longa; folia maxima 13 cm. longa, prope basin 16 mm. lata, apicem versus sensim angustata, vaginae purpureo-suffusae; inflorescentiae flores 1–3 ferentes; *flores* pallide lilacini, labello maculo flavo medio ornato; *sepalum dorsale* 12 mm. longum, 6 mm. latum; mentum 12 mm. longum, fere rectum; *petala* 12 mm. longa, 4½ mm. lata, acuta; labellum cum apice pedis gynostemii junctum, calcar 5 mm. longum faciens, pars libera labelli 17 mm. longa, fere plana, lamina quam ungue paullo latior, 4½ mm. lata, apice abrupte angustata, obtusa, basi carinis 2 humilibus V-forme convenientibus instructa, conjunctio carinarum leviter elongata, libera, in ore calcaris posita.

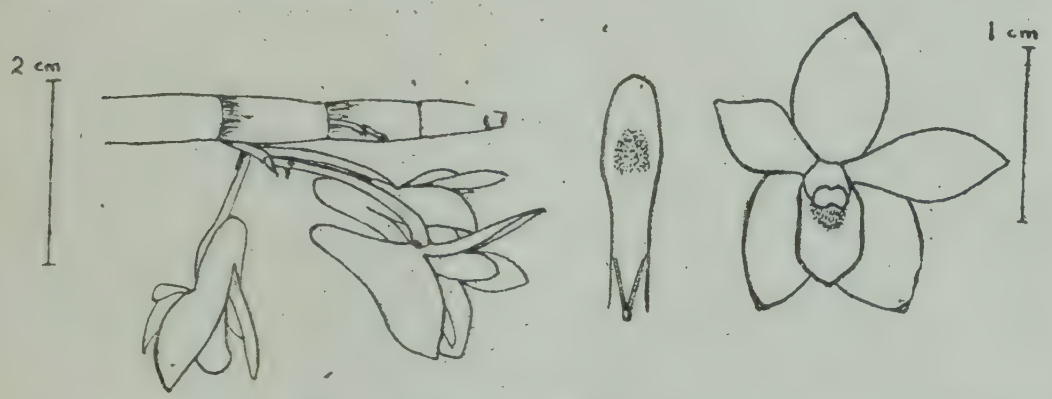


Fig. 3. **Dendrobium brinchangensis**: end of pseudobulb with one inflorescence; upper surface of free part of labellum; flower in face view.

TYPE: G. Brinchang, Cameron Highlands, S.F.N. 23533, leg. Holttum.

Allied to *D. cornutum* Hk. f. but differing in colour, in the equal length of upper sepal and mentum, the nearly flat lip with abrupt apex and longer closed spur. Found on three occasions on G. Brinchang, where it is common at 5500–6000 ft., flowering in April, August and December.

Dendrobium (§ Conostalix) **melanochlamys** Holtt., nom. nov.

D. villosulum Wall. apud. Hk. f., F.B.I. 5: 728. 1890. (Not *D. villosulum* Lindl. 1852).

Dendrochilum Blume.

It is now usual to unite Platyclinis with this genus. Some of Ridley's species of Platyclinis have not yet been transferred to Dendrochilum: the necessary new combinations are proposed below.

Dendrochilum carnosum (Ridl.) Holtt., comb. nov.

Basinym: *Platyclinis carnosa* Ridl., Journ. F.M.S. Mus. 6: 56. 1915.

Dendrochilum gramineum (Ridl.) Holtt., comb. nov.

Basinym: *Platyclinis graminea* Ridl., Journ. F.M.S. Mus. 6: 57. 1915.

Dendrochilum lineare (Ridl.) Holtt., comb. nov.

Basinym: *Platyclinis linearis* Ridl., J. Linn. Soc. 32: 230. 1896.

Eria (§ Hymeneria) **clavata** Holtt., sp. nov.

Pseudobulbi c. 4 cm. longi, 1 cm. diam., 2–foliati; folia c. 7 cm. longa, 1·4 cm. lata; inflorescentia erecta, 4 cm. longa, flores 8 ferens; bracteae pallide virides, 8 mm. longae, 4 mm. latae; sepala petalaque alba, apice pallide rubra; *sepalum dorsale* 8 mm. longum, 3½ mm. latum; *sepala lateralia* cum pede gynostemii mentum 4 mm. longum formantia, mentum angulum 60° cum ovario faciens; *labellum* trilobatum, pallide rubrum, lobis lateralibus carinisque atropurpureis, latere visum e basi ad apicem curvatum, carinis 3 basin versus donatum, carina media in lobum intermedium producta, in callo parvo semiorbiculare terminata; lobus intermedius apice recurvus, leviter emarginatus, medio carnosus, papillosus, parte carnosa basin versus ampliata, ad basin labelli producta.

TYPUS: Fraser's Hill, leg. C. E. Carr, 1929.

In habit this species resembles *E. Maingayi*, but differs in broader leaves and different colour and shape of flowers.

Habenaria sumatrana Schltr., var. **major** Holtt., var. nov.

A speciei typica differt: floribus majoribus; sepalis petalisque 7–8 mm. longis; labello 12 mm. longo, basi viride 6 mm. longa et 3 mm. lata, lamella alba abrupte ampliata, 12 mm. lata, 3–lobata, lobis lateralibus angulo 60° patentibus, rhomboideis, 4 mm. latis, margine leviter dentatis, lobo intermedio obtuso, 2 mm. longo, 1 mm. lato, calcare 3 mm. longo.

This variety is rather common in open places in Kedah. It should perhaps rank as a separate species; but further information about the variation of *H. sumatrana* is needed before this can be decided. The form of *H. sumatrana* described from Java by J. J. Smith seems to be larger than that common in Malaya, and perhaps comes between the latter and var. *major*.

Kuhlhasseltia Carrii Holtt., sp. nov.

Planta florens c. 18 cm. alta; lamina folii c. 4 cm. longa, 14 mm. lata, elliptica, acuta, petiolus cum vagina 16 mm. longus; scapus 11 cm. longus, breviter pubescens, bracteas steriles 3, ad 4 cm. longas, ferens; rachis brevis, flores 3 ferens; bracteae ad 9 mm. longae, marginibus hirsutis, cetera glabrae; ovarium c. 10 mm. longum, pubescens; *sepalum dorsale* 8 mm. longum, glabrum; *sepala lateralia* basin labelli amplectentia; *petala* angusta, sepalo dorsali agglutinata; labellum 8 mm. longum, basi saccata 15 mm. alta, lamella bilobata, lobi patentes, 2½ mm. longi, 13 mm. lati.

TYPUS: Fraser's Hill, leg. C. E. Carr, November 1930.

This has larger flowers than the other species of the genus, and much larger leaves.

Liparis (§ Platystylis) **hirundo** Holtt., sp. nov. Fig. 4.

Pseudobulbi ovoidei, c. 6 mm. alti, 2–foliati; folii lamina ad 2 cm. longa, 5 mm. lata, elliptica, acuta, petiolus cum vagina infra articulum ad 6 mm. longus; inflorescentia ad 7 cm. longa, tenuissima, scapus brevis, anguste alatus; rachis anguste alata, flores c. 5 mm. dissiti, bracteae 2–3 mm. longae; pedicellus cum ovario 5–6 mm. longus; *sepala* 3½ mm. longa, marginibus revolutis; *sepala lateralia* post labellum adjacentia, pro parte adjuncta; *petala* angustissima haud 2½ mm. longa, reflexa; labellum 2½ mm. longum, basi ad gynostemium adpressum, carnosum, antice excavatum, cetera angulum 90° cum gynostemio faciens, prope basin abrupte ampliatum, fere oblongum, angulis basalibus leviter productis et recurvis, apice brevissime

acutum; *gynostemium* 2½ mm. longum, curvatum, utroque latere alatum, prope stigma alis duabus angustis 1½ mm. longis reflexis, antice infra apicem alis duabus brevibus late triangularibus donatum.

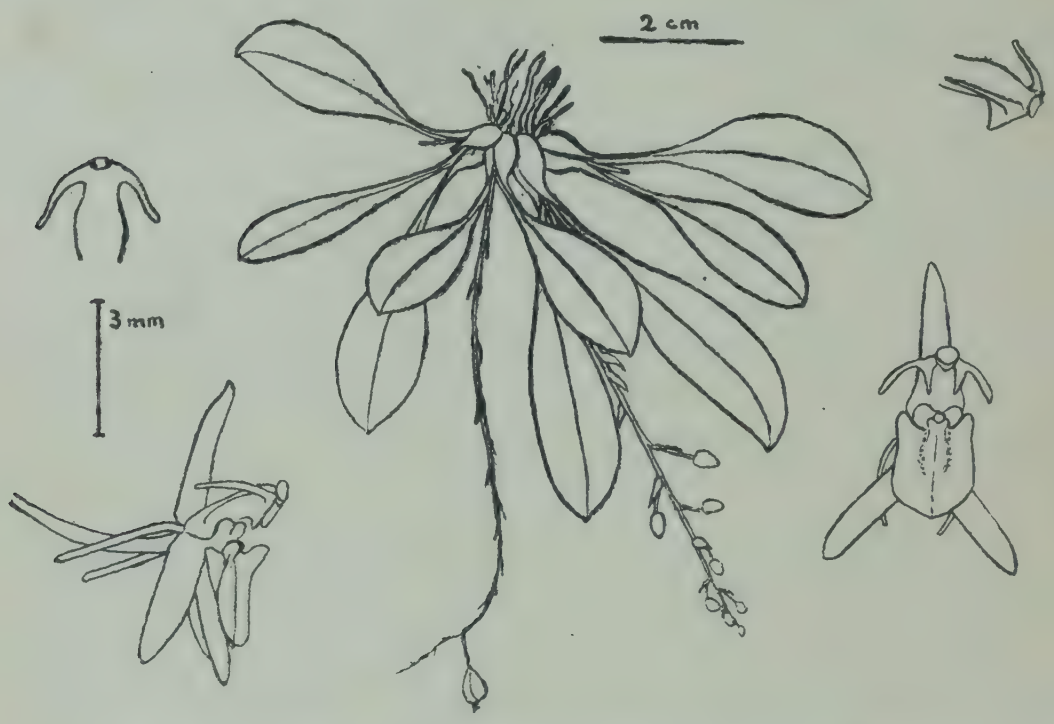


Fig. 4. **Liparis hirundo:** plant in natural position; flower in front and side view; column from back and side.

TYPUS: Cameron Highlands, leg. Batten-Pooll, 1939–40.

This species is related to *L. decurrens* and a few others of Java, Sumatra and the eastern Himalayas, but none of them are so small, and none have the long wings on each side of the stigma. These wings are spreading and curved backwards, and in that position have the shape of a swallow's wings in flight, the anther representing the head of the bird and the front column-wings its breast. The flowers are a pale salmon-pink, the lip deeper in colour than the rest. The leaves are pale green, and the plants hang from the branches of trees beside small forest streams in sheltered places.

Malaxis Soland.

It is now usual to include Microstylis Nutt. in Malaxis. Some species of the Peninsula need transferring to the latter genus, and the new names are proposed below.

Malaxis macrochila (Rolfe) Holtt., comb. nov.

Basinym: *Microstylis macrochila* Rolfe, Kew Bull. 1895: 6.

Malaxis nemoralis (Ridl.) Holtt., comb. nov.

Basinym: *Microstylis nembralis* Ridl., J. Str. Br. R.As. Soc. 54: 47. 1910.

Malaxis perakensis (Ridl.) Holtt., comb. nov.

Basinym: *Microstylis perakensis* Ridl., J. Linn. Soc. 32: 222. 1896.

Malaxis reniloba (Carr) Holtt., comb. nov.

Basinym: *Microstylis reniloba* Carr, Gard. Bull. S.S. 7: 5. 1932.

Malaxis stenophylla Holtt., sp. nov.

Pseudobulbi c. 1 cm. alti, folia c. 6 ferentes; *folia* maxima 6 cm. longa et 6 mm. lata, apicem versus angustatus, marginibus leviter crispata, basi vaginata, vagina 10 mm. longa; inflorescentia ad 12 cm. alta, tenuis, scapus ad 5 cm. longus; flores 3–5 mm. dissiti, simul aperti, pauci; bracteae 3½ mm. longae, pedicelli cum ovariis 4–5 mm. longi; *sepala* 2 mm. longa, làta; *petala* valde angustiora; *labellum* totum 2½ mm. longum, fere 2½ mm. latum, 3-lobatum, lobi magnitudine fere aequales; lobi laterales elliptici, obliqui, post gynostemium in auriculis rotundatis brevibus producti; lobus intermedius cordatus, apice breviter bidentatus, dentes leviter incurvi, sinus rotundatus; *gynostemium* breve, alis brevibus donatum.

TYPUS: Trengganu, G. Padang, alt. 4000 ft., S.F.N. 33932, leg. Moysey.

This species is probably nearest to *M. calophylla*, but has very narrow leaves, and a distinctly trilobed lip. The shape of the side-lobes is nearly as in *M. reniloba* (Carr), but the whole lip is much smaller in *M. stenophylla* and the midlobe proportionately much larger than in *M. reniloba*. No colours of the flowers were recorded.

Malleola altocarinata Holtt., sp. nov.

Caulis brevis, pendulus; *folia* pauca, c. 8 cm. longa, 2·5 cm. lata, oblanceolata, apice obtusa inaequaliter bilobulata; inflorescentia c. 10 cm. longa, pendula, multiflora; flores 8 mm. longi; *sepalum dorsale* supra gynostemium cucullatum, c. 4 mm. longum, 2½ mm. latum; *sepala lateralia* patentia, 4 mm. longa, 2½ mm. lata; *petala* 3½ mm. longa, haud 2 mm. lata, acuta; labellum ovarium versus reflexum; lobi laterales carnosi, humiles, rotundati, leviter patentes; lobus intermedius anguste triangularis, carnosus, apice reflexus, 2 mm. longus, basi alto-carinatus, carina supra ostium calcaris elevata, basi utroque latere ad lobos laterales juncta; calcar sub ostio primo late cylindricum,

3 mm. longum et 2 mm. latum, demum constrictum, apice fere globosum, 1 mm. diam., intus postice callo parvo instructum; *gynostemium* 1½ mm. altum.

TYPUS: Ginting Simpah, Selangor, leg. Mungo Park, October 1932.

This is allied to *M. aberrans* from Celebes and *M. baliensis* from Bali and Java; all agree in having a high keel at the base of the midlobe of the lip.

Malleola macranthera (Ridl.) Holtt., comb. nov.

Basinym: *Saccolabium macrantherum* Ridl., Kew Bull. **1926**: 478.

Synonym: *Abdominea macranthera* Carr, Gard. Bull. S.S. **7**: 54, pl. 5B. 1932.

I think Carr was mistaken in including this species in Abdominea. The large rostellum of *Abdominea minimiflora* (Hk. f.) J.J.S. has a narrow base and is quite different in shape from that of *Saccolabium macrantherum* Ridl. Abdominea also has four pollinia, and a lip of quite different shape. The column and spur of *S. macrantherum* agree quite well in shape with species of Malleola, and the stipes of the pollinia also.

Oberonia calcicola Holtt., sp. nov.

Caules brevissimi, folia c. 6 ferentes; *folia* flabelliforme patentia, maxima 5·5 cm. longa, 9 mm. lata, fere recta, e basi lata sensim angustata, apice breviter acuta; inflorescentia c. 10 cm. longa, erecta vel apice nutans, scapus c. 1 cm. longus; *flores* in verticillis c. 6–floribus dispositi, verticilli 2 mm. dissiti; bracteae 2 mm. longae, fere integrae; sepala petalaque integra; *sepala* reflexa, late ovata, lateralia quam dorsale latiora; *petala* anguste oblonga; labellum petalis aequilongum, basi carnosum, 3–lobatum; lobi laterales parvi, breves, fere quadrangulares, integri; lobus intermedius oblongus, e basi paullo ampliatus, apice bilobatus, lobuli angusti, acuti, breves, sinus latus.

TYPUS: Langkawi, S.F.N. 21398, leg. Henderson. The flower on the only specimen is old and the details of the lip uncertain.

Oberonia flabellifera Holtt., sp. nov.

Caules ad 2·5 cm. longi, leviter sinuati, 3–5–foliati; *folia* angulum infra 45° cum caule facientia, supra basin vaginata c. 1·5 cm. longa, 2½ mm. lata, oblonga, breviter acuta; inflorescentia ad 7 cm. longa, scapus 10 mm.; *flores* in verticillis c. 7–floribus dispositi, verticilli 3–4 mm. dissiti; bracteae breves, latae, margine minute papillosae; pedicellus cum ovario 1 mm. paullo superans; sepala petalaque pallide flavescentia, omnia patentia, aequilonga, flos totus 1½ mm.

latus; *sepala* late ovata, fere aequalia, integra, sepalum dorsale obtusum, lateralia acuta; *petala* quam dimidium sepali paullo latiora, obovata, margine irregulariter dentata; labellum ochraceum, petalis aequilongum, circumscriptione fere semiorbiculare, 3–lobatum; lobus intermedius angustus, apicem versus ampliatus, apice plus minusve emarginatus; lobi laterales flabelliformes, profunde incisi, dentes basin labelli versus decrescentes.

TYPUS: Johore, Mawai, S.F.N. 28162, leg. E. J. H. Corner.

Also found on old mangrove in Singapore. The side-lobes of the lip almost meet the midlobe, which is not very distinct; otherwise the lip is very like that of *O. stenophylla*, but the leaves are very short and the apices of the sepals not deflexed.

Oberonia transversiloba Holtt., sp. nov.

Caules c. 4·5 cm. longi, c. 6–foliati; *folia* cum caule angulum parvum facientia, fere recta, apicem versus leviter incurva, acuta, prope basin valde articulata, supra articulum c. 9·5 cm. longa, 5 mm. lata; inflorescentia erecta, ad 16 cm. longa, scapus 6 cm.; *flores* in verticillis c. 6–floribus dispositi, verticilli 2½–3 mm. dissiti; bracteae integrae; pedicellus cum ovario 2 mm. longus; sepalum dorsale petalaque patentia, integra, fere aequalia; petala tamen apice angustiora; sepala lateralia latiora, reflexa; labellum aurantiaco-flavum, 3–lobatum, petalis aequilongum, fascia humile e basi fere ad apicem donatum; lobi laterales parvi, rotundati; lobus intermedius transverse oblongus, marginibus leviter et irregulariter dentatis.

TYPUS: Pahang, Gua Tipus, S.F.N. 19448, leg. M. R. Henderson.

Octarrhena condensata (Ridl.) Holtt., comb. nov.

Oberonia condensata Ridl., Journ. Linn. Soc. 38: 322. 1908.

I have collected fresh specimens of this species at Cameron Highlands and compared them with the type. This species is much larger than *Octarrhena parvula*, with stems to 20 cm. long, leaves to 3·5 cm. long and 5 mm. wide, much flattened laterally, and crowded flowers of a deeper yellow colour.

Pennilabium acuminatum (Ridl.) Holtt. comb. nov.

Basinym: *Sarcochilus acuminatus* Ridl., Journ. F.M.S. Mus. 4: 72. 1909.

I have examined the type of this species; it is certainly a Pennilabium.

Phaius longipes (Hk. f.) Holtt., comb. nov.

Basinym: *Calanthe longipes* Hk. f., F.B.I. **6**: 195. 1890.

Oldest name: *C. gracilis* Lindl., Gen. et Sp. Orch 251. 1833. (Not *Phaius gracilis* Hayata 1911).

Though aberrant in the genus Phaius, this species, with column and lip not joined together, appears to me better placed in Phaius than in Calanthe.

Phaius pauciflorus Bl., Mus. Bot. 2: 181. 1852. (Limatodis Bl. 1825), var. **pallidus** (Ridl.) Holtt., stat. nov.

Basinym: *Phaius pallidus* Ridl., Journ. Linn. Soc. **32**: 313. 1896.

Synonym: *Limatodis pallidus* Ridl., Fl. Mal. Penin. **4**: 124. 1924.

Three varieties of *P. pauciflorus* have been described in Java and Sumatra (*see* J.J.S. in Fed. Rep. 32: 238 for synonymy). The Malay Peninsula plants appear to me to come within the range of the species so interpreted, but are slightly different from var. *sumatranus*.

Phalaenopsis decumbens (Griff.) Holtt., comb. nov.

Basinym: *Aerides decumbens* Griff., Notul. **3**: 365. 1851. Ic. t. 320.

Synonyms: *Kingiella decumbens* Rolfe, Orch. Rev. **25**: 197. 1917. Ridl., Flora 4: 158.

Phalaenopsis wightii Rchb. f., Bot. Zeit. **1862**: 214.

Doritis wightii Benth., Gen. Plant. **3**: 574. 1883. King & Pantl., Ann. Calc. **8**: 198, t. 265.

Phalaenopsis hebe Rchb. f., Hamb. Gartenz. **18**: 35. 1862. J.J.S., Fl. Buit. **6**: 550, fig. 417.

I can see no clear distinction between Pantling's illustration of *Doritis wightii* and J. J. Smith's of *Phalaenopsis hebe*. I agree with J. J. Smith in referring this species to Phalaenopsis, and it appears that Griffith's is the oldest name.

Pholidota longibulba Holtt., sp. nov.

Pseudobulbi 1–2 cm. dissiti, 7–9 cm. longi, prope basin 15–20 mm. lati, apicem versus sensim attenuati, valde angulati, laeves, unifoliati. Lamina folii ad 30 cm. longa et 5·5 cm. lata, oblanceolata, apice breve acuminata, venae primariae 5, petiolus 2½–4 cm. longus. Inflorescentia cum folio immaturo in apice pseudobulbi immaturi explicata; scapus tandem 18 cm. longus, haud 1 mm. diametro, erectus; rachis ad 18 cm. longa, nutans, flexuosa, internodia c. 4 mm. longa; bracteae deciduae, 9 mm. longae, 5 mm. latae, ellipticae, apice rotundatae; pedicelli nulli, ovarium 2½ mm. longum. *Sepalum dorsale* 4½ mm. longum, 3½ mm. latum, ovatum, apice rotundatum, concavum; *sepala lateralia* 5 mm.

longa, valde carinata, concava. *Petala* 3½ mm. longa, 2 mm. lata, ovata, acuta. Saccus labelli 3½ mm. longus, 2½ mm. latus, intus 3–venulosus, venulis non carinatis, antice lobum unicum ferens; lobus recurvatus, explicatus reniformis, 3½ mm. latus, 2 mm. longus, basi callo leviter bilobo cum sacco junctus. *Gynostemium* 2 mm. longum, 1½ mm. latum; rostellum fere erectum; alae laterales angustae, lobo parvo triangulo prope stigma instructae; ala apicalis brevis, truncata; anthera fere horizontalis, explicata 1·7 mm. lata, 1·3 mm. longa.

TYPUS: Pahang, Cameron Highlands, 4800 ped. alt., leg. Holttum, Aug. 1946.

Pomatocalpa setulense (Ridl.) Holtt., comb. nov.

Basinym: *Saccolabium setulense* Ridl., J.S.B.R.A.S. 59: 198. 1911.

I have examined the type of this species; it is a Pomatocalpa, as defined by J. J. Smith.

Rhynchostylis gigantea (Lindl.) Ridl., var. **Harrisoniana** (Hk.) Holtt.

Basinym: *Saccolabium Harrisonianum* Hk., Bot. Mag. t. 5433. 1864.

It appears to me that Hooker's species is no more than a colour variety of *R. gigantea*.

Sarcanthus capricornis (Ridl.) Holtt., comb. nov.

Basinym: *Ascochilus capricornis* Ridl., Flora Mal. Penin. 4: 181. 1924.

I have examined the type of this species at Kew. It is undoubtedly a Sarcanthus, and appears to be distinct from any other species already described, though very near to the Siamese *S. recurvus* Downie, which has a larger inflorescence and smaller flowers. The following is a revised description.

Stems to about 15 cm. long, internodes about 5 mm. long; leaves 2½–4 cm. long, terete, strongly recurved, acute, about 3 mm. thick; inflorescences about 6 cm. long including the scape of barely 1 cm.; bracts 1 mm. long, 3 mm. apart; pedicel and ovary 8 mm. long; *upper sepal* nearly 4 mm. long; *petals* about 3 by 1½ mm.; lip with saccate non-septate spur 1½ mm. long and wide, erect broadly rounded side-lobes 2 mm. long and wide, narrowly triangular mid-lobe 3 mm. long and 2 mm. wide, with short hairs at the entrance to the spur, and a thick bluntly triangular back-callus; column–foot about 2 mm. long. "Upper petal (*i.e.*, sepal) magenta, lower petals brownish green mottled with red" (collector's note).

Sarcanthus inflexilobus Holtt., sp. nov.

Caulis 5 cm. longus, c. 10–foliatus; *folia* ad 16 cm. longa et 1 cm. lata, carnosa, apice sensim angustata, bilobulata, obtusa, infra valde carinata; inflorescentia simplex vel ramulis 1–2 instructa, ad 15 cm. longa; scapus 5 cm. longus; *sepalum dorsale* 3 mm. longum, 1½ mm. latum, obtusum; *petala* 2½ mm. longa, haud 1 mm. lata; labellum ex apice calcaris ad apicem lobi intermedii 6 mm. longum; calcar anguste conicum, 3 mm. longum, prope apicem solum longitudinaliter septatum; lobi laterales horizontaliter inflexi, in medio ostii calcaris fere congredientes; callus ad basin gynostemii T–formis (antice visus), capite supra ostium calcaris elevato, basi in lacunam inter lobos laterales descendens; lobus intermedius concavus, non callosus, sagittatus, 2½ mm. longus et latus, lobulis basalibus angustatis, acutis, elevatis, apice obtusa leviter reflexa.

TYPUS: Gua Musang, Kelantan, August 1929, leg. C. E. Carr.

Sarcanthus ionosmus (Ridl.) Holtt., comb. nov.

Basinym: *Cleisostoma ionosmum* Ridl., Journ. Linn. Soc. 32: 336. 1896 (not of Lindley).

Synonym: *Saccolabium ionosmum* Ridl., Mat. Fl. Mal. Penin. 1: 170. 1907.

I have examined the type of this species.

Sarcanthus lanatus (Lindl.) Holtt., comb. nov.

Basinym: *Cleisostoma lanatum* Lindl., Journ. Hort. Soc. 4: 164. 1849.

Synonym: *Sarcanthus bracteatus* Ridl., J. Linn. Soc. 32: 370. 1896.

I have examined the type of Ridley's species, and find it to agree with *Saccolabium lanatum* Hk. fil., as figured in Ann. Calc. 5, t. 72. It is peculiar in its hairiness, but seems to be a true Sarcanthus in flower-structure.

Sarcanthus rugulosus (Ridl.) Holtt., comb. nov.

Basinym: *Saccolabium rugulosum* Ridl., J.S.B.R.A.S. 39: 82. 1903.

I have examined the type of this species.

Sarcochilus carrii Holtt., sp. nov.

S. siamensis sensu Carr, Gard. Bull. S.S. 5: 31, pl. XI, B (1929), non *Ascochilus siamensis* Ridl., Journ. Linn. Soc. 32: 375. 1896.

Caules brevissimi, c. 5–foliati; *folia* ad 4 cm. longa, 12 mm. lata; scapus tenuis, minute asperus, erectus, quam folia brevior; rachis brevis, bracteae brevissimae; flores pallide flavescentes, labellum album; *sepala* c. 3½ mm. longa, lateralia 2 mm. lata, dorsale angustius; *petala* 3 mm. longa, haud 1 mm. lata; labellum ecalcaratum, dorso lineam

pedis gynostemii continuans, 3 mm. longum; lobi laterales oblique erecti, obovati, apice rotundati, postice 2½ mm. longi, 1·2 mm. lati; lobus intermedius valde carnosus, antice visus oblongus, breviter acutus, sectione longitudinale triangularis; *gynostemium* c. 1·2 mm. longum; pes gynostemii aequilongum, cum gynostemio angulum 90° faciens.

TYPUS: Mentakab, Pahang, leg. C. E. Carr.

This species resembles the true *S. siamensis* (Ridl.) Carr in general appearance and colouring, but has no spur. Carr correctly showed that the two species were distinct and figured them both; but he evidently did not carefully examine the type of *Ascochilus siamensis*, which agrees with the specimen he named *S. mentakabensis*. The specimen figured by him as *S. siamensis* therefore needs a new name and diagnosis.

Sarcochilus johorensis Holtt., sp. nov.

Caulis brevis, c. 5–foliatus; *folia* ad 8 cm. longa, 15 mm. lata, obtusa; scapus 3 cm. longus, asperulus; rachis 1 cm. vel ultra longa, incrassata; flores conferti; bracteae 2 mm. longae, latae, obtusae; pedicellus cum ovario c. 8 mm. longus; sepala petalaque pallide sordide flavescentia; sepala extus breviter hirsuta; *sepalum dorsale* 11 mm. longum 5 mm. latum, obovatum, acutum; *sepala lateralia* brevissime ad pedem gynostemii juncta; *petala* 10 mm. longa, 3½ mm. lata; labellum 7·7 mm. longum, fere lineam pedis gynostemii continuans (calcar leviter inflexum); lobi laterales sordide rufobrunnei, erecti, rotundati, apicem versus ampliati, 2½ mm. lati; lobus intermedius carnosus, supra calcar sedens, 2½ mm. longus, 2 mm. altus, lateraliter compressus, apicem versus elevatus, antice angulum 90° cum calcare faciens; calcar quam lobus intermedius 3 mm. longius, rectum, cylindricum, 2 mm. diam., gynostemium 6½ mm. longum; pes gynostemii 5 mm. longum.

TYPUS: Johore, Sedili River, leg. C. E. Carr, October 1932.

Sarcochilus minutiflorus (Ridl.) Holtt., comb. nov.

Basinym: *Ascochilus minutiflorus* Ridl., J.S.B.R.A.S. 39: 85. 1903.

Ridley's Ascochilus is not very sharply differentiated from Sarcochilus and I prefer to unite it with Sarcochilus.

Thrixspermum scopa (Hk. fil.) Holtt., comb. nov.

Basinym: *Sarcochilus scopa* Hk. fil., F.B.I. **6**: 40. 1890.

(*Thrixspermum arachnites* quoad Ridl., Flora M.P. 4: 185, p.p.).

This species appears to be distinct from *T. arachnites* (Bl.) Rchb. f. in its much longer stems (internodes 2·5 to

5 cm. long, as compared with 1 cm. in *T. arachnites*), but is very similar in its flowers. The two need to be cultivated side by side and critically compared.

Thrixspermum (§ Dendrocolla) **duplocallosum** Holtt., sp. nov. **Fig. 5.**

Caulis c. 4 cm. longus, paucifoliatus, internodia 4 mm. longa; *folia* c. 6 cm. longa, 11 mm. lata, non carnosa, apice bilobata, subtus purpurea; scapus purpureus, 4·5 cm. longus, rachis 8 mm. longa, bracteae 2 mm. longae, late triangulares, purpurascentes; pedicellus cum ovario 5 mm. longus; sepala petalaque alba, leviter roseo-tincta; *sepalum dorsale* 6½ mm. longum, 3¼ mm. latum, *sepala lateralia* 4 mm. lata; petala 2¼ mm. lata; labellum *petalis* sepalisque aequilongum, glabrum, aurantiacum, callis duobus sordide sanguineis instructus, lobi laterales erecti, 2½ mm. alti, rotundati, antice non prominentes, lobus intermedius 2¼ mm. latus, semiorbicularis, reflexus, margine dentatus, callus anticus basi lobi intermedii positus, latus, medio depressus, antice bilobatus callus posticus longitudinaliter extensus, extremis utrisque breviter liberis; *gynostemium* album, 2½ mm. longum, pes gynostemii 2½ mm. longus, pallide purpurascens; capsula purpurea, 5½ cm. longa.

TYPUS: Cameron Highlands, 4,800 ft. alt., leg. Holttum August. 1946.

Found on a tree in valley forest near waterfall; described from living plant.

Thrixspermum (§ Dendrocolla) **brevicapsularis** Holtt., sp. nov. **Fig. 5.**

Caulis 18 cm. longus, multifoliatus, internodia 10 mm. longa; *folia* 4–5 cm. longa, 5–6 mm. lata, valde carnosa, apice angusto bilobata, omnino purpureo-maculata; scapus 4–6 cm. longus, rachis ad 10 mm. longa, cylindrica, bracteae 1 mm. longae, tenues, apice tantum eminentes, pallide virides; flores eis *T. duplocallosi* similes, different: *sepalis petalisque* leviter lutescentibus, labello flavo, medio aurantiaco, basi aurantiaco-striato, callo antico sordide aurantiaco, callo postico antice sordide purpureo, lobo intermedio triangulare, margine non dentato, apice acuto, capsula 3–3½ cm. longa, viride, leviter purpureo-maculata.

TYPUS: Cameron Highlands, 4,800 ft., on an old coffee bush in exposed place, leg. Holttum Aug. 1946. Described from living plant.

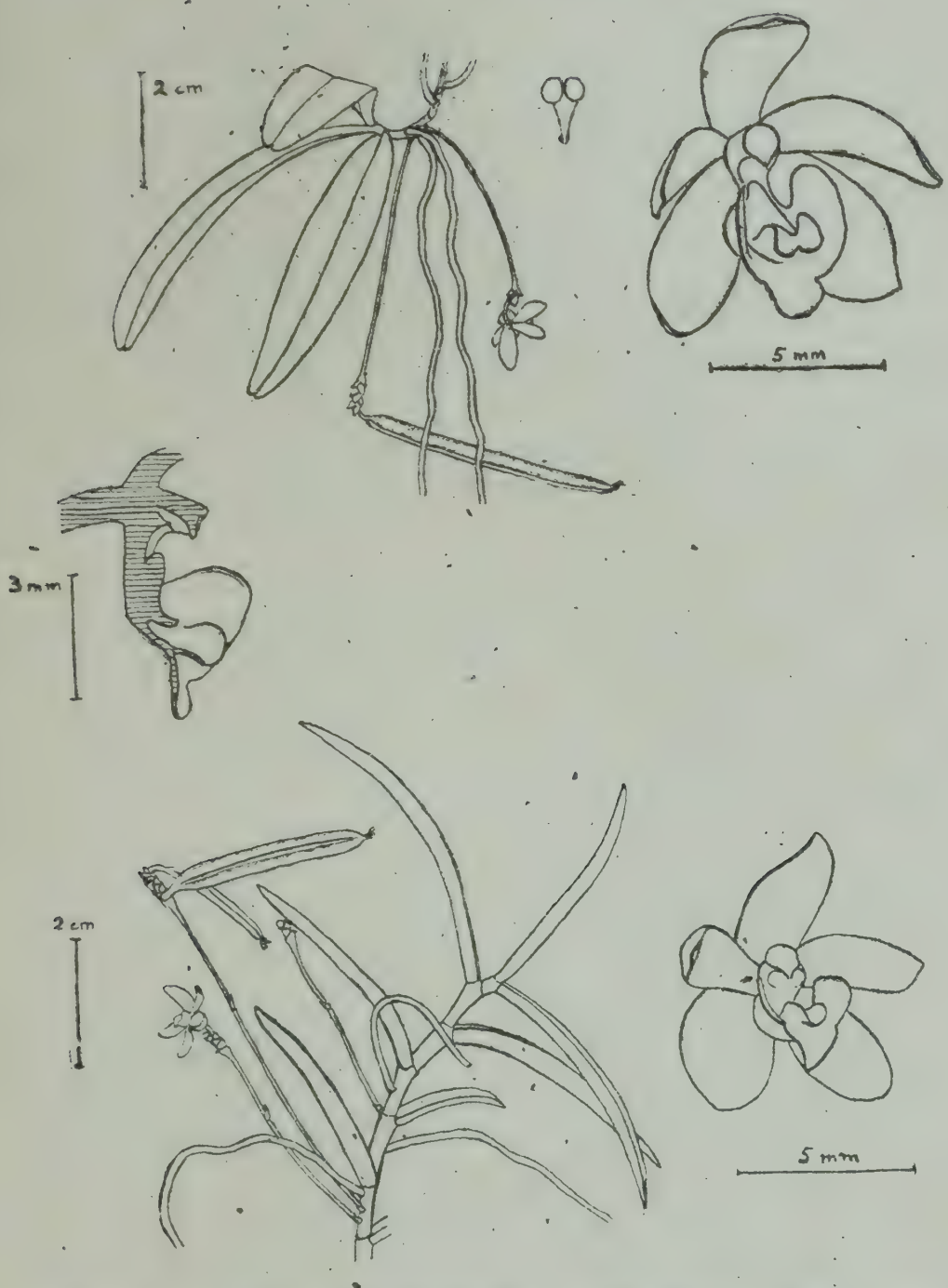


Fig. 5. (above) **Thrixspermum duplocallosum:** whole plant; flower; pollinia; longitudinal section of flower.
(below) **T. brevicapsularis:** apical part of plant and a single flower.

Thrixspermum (§ Dendrocolla) **Corneri** Holtt., sp. nov.

Caulis brevis, c. 3–foliatus; *folia* teretia, ad 4 cm. longa, fere 3 mm. lata; scapus 10 mm. longus; rachis inflorescentiae incrassata, brevis; bracteae latae, breves, breviter acutae; pedicellus cum ovario 5 mm. longus; flores pallide flavescentes, labello pallide brunneo-maculato; *sepalum dorsale* 4½ mm. longum, 3 mm. latum, late acutum; *sepala lateralia* late cum pede gynostemii juncta, 4 mm. lata; *petala* obovata, obtusa, 2½ mm. lata; labellum e basi gynostemii ad apicem lobi intermedii 4 mm. longum, ex apice loborum lateralium ad fundum sacci 7 mm. altum; lobi laterales erecti, late rotundati; lobus intermedius truncatus, carnosus, brevissime pilosus; callus bifidus; saccus intus e callo ad fundum fascia longe-pilosa instructus; *gynostemium* breve, pes gynostemii 2½ mm. longum.

TYPUS: Mawai, Johore, by Sedili River, leg. E. J. H. Corner. (Specimen preserved in alcohol).

Thrixspermum platycaule Holtt., nom. nov.

Basinym: *Sarcochilus anceps* Ridl., J.S.B.R.A.S. **54**: 53. 1909. (Not *Thrixspermum anceps* (Bl.) Rchb.f.).

I have examined the type of this species; the lip is that of Thrixspermum, not Sarcochilus.

Trichoglottis misera (Ridl.) Holtt., comb. nov.

Basinym: *Saccolabium miserum* Ridl., Journ. Linn. Soc. **32**: 359. 1896.

The type of this species has the usual tongue of Trichoglottis at the base of the column, but not the horns on either side of the column usually found in that genus; there is a fleshy thickening on either side of the rostellum.

Uncifera tenuicaulis (Hk. f.) Holtt., comb. nov.

Basinym: *Saccolabium tenuicaule* Hk. f., F.B.I. **6**: 64. 1890.

This species differs from the others hitherto referred to Uncifera in having inflorescences of 1–3 flowers, the spur curved upwards in front, hairs within the spur, and the tip of the stipes not recurved. In other respects it agrees with the other species of Uncifera, and it appears not to be referable to any other genus at present recognized.

CYPERACEAE

Mapania cuspidata (Miquel) Holtt., comb. nov.

Basionym: *Lepironia cuspidata* Miq., Fl. Ind. Bat. Suppl. 603. 1860.

Synonyms: *Lepironia humilis* Miq., Ill. Fl. Arch. Ind. **61**, t. 21. 1871. (but not *Pandanophyllum humile* Miq. 1855).

Mapania lucida N.E. Br. in Ill. Hort. **32**: 77, t. 557. 1885.

M. triquetra Ridl., Journ. Str. Br. R. Asiat. Soc. **41**: 51. 1903.

M. petiolata var. *cuspidata* Uittien, Rec. Trav. Bot. Néerl. **33**: 282. 1936.

This is perhaps not sharply distinct from *M. petiolata*, though extreme forms are very different. If the two are united, as by Uittien (l.c.), the name *cuspidata* must be used, being older. But I suggest maintaining them separate pending further field study.

Mapania insignis Holtt., sp. nov.

M. inopinatae Uittien affinis, differt foliis, scapis, spiculis multo majoribus.

Leaf-sheaths to 20 cm. long, petioles to 40 cm. long and 8 cm. wide, leaf-blades to 60 cm. long and 11 cm. wide, caudate apex to 15 cm. long. *Scape* 12–35 cm. long, 3–4 (–5?) mm. diameter, very shortly and densely rough-hairy throughout (almost as in *M. palustris*), rusty in appearance when dried, basal sheaths stiff, acute, to 8 cm. long. *Inflorescence* a head of 8–16 sessile spikelets, the whole 3½–6 cm. across, with stiff acute primary bracts to 3 cm. long. *Spikelets* 2–2½ cm. long, 1 cm. wide, the longer ones with acute apex. *Glumes* 9–11 mm. long, narrowly oblong with rounded apex, inner ones thin; *scales* as long as glumes, the lateral outer scales hairy on keels near apex only. *Nut* not seen.

TYPUS: Pahang, Gunong Tahan, 3,000 ft., S.F.N. 20584, leg. Holttum 27-8-1928. Also at same locality S.F.N. 8125 (Haniff & Nur) and Ridley 16192; and at Karak F.R., Pahang, S.F.N. 13883 (Best).

Like *M. inopinata*, this has the inflorescence of section Halostemma and the vegetative habit of *M. petiolata* C. B. Clarke which, on account of its simple spikelet, is placed in section Pandanophyllum. Clarke however reports (F.B.I. 6: 683) that *M. petiolata* (there called *M. humilis*) may have small secondary spikelets in the axils of the basal bracts, and so may other species, so that the distinction between the two sections is not a sharp one, and I doubt if it should be maintained. The group of *M. petiolata*

C. B. Cl., characterized by the petioled leaves, is however very distinct, and should perhaps constitute a separate section of the genus.

Mapania micropandanus Holtt., sp. nov.

Caulis erectus, radicibus rectis obliquis sustentus. *Folia* c. 30 cm. longa, 8–13 mm. lata, tenuia, pallida, basi leviter angustata et complanata, apice breviter et aequaliter angustata, non caudata, margine per totam longitudinem acute denticulata, *venae primariae* 3, media subtus laterales supra elevatae, omnes omnino denticulatae. *Scapus* brevissimus. *Spicula* florens 15 mm. longa, 5 mm. lata; *glumae* pallidae, tenues, 10 mm. longae, multinervosae, nervis concoloribus, in sicco leviter elevatis.

TYPUS: Johore, S. Kayu Ara, Mawai-Jemaluang Road, S.F.N. 29362, leg. E. J. H. Corner, 5th May 1935. Also Pulau Tioman, 1,000 ft., Burkill s.n. June 1915.

This little species, like a miniature Pandanus, occurs in dry Dryobalanops forest and in the drier parts of the (fresh-water) swampy forest in the Sedili River area, S.E. Johore. It is distinct from all other species in the shape and size of its leaves, which are in texture rather like those of *M. tenuiscapa* C. B. Cl. but shorter, shortly pointed, with only 3 main veins which are finely toothed on their raised surface almost from base to apex of the leaf (they are smooth in *M. tenuiscapa*).

Scleria cyathophora Holtt., sp. nov.

Caules approximati, fere 100 cm. longi, 2½–3 mm. diametro, acute triquetri, laeves. *Folia* maxima fere 30 cm. longa, 5 mm. lata, apice longe acuminata, haud scaberula; *vaginae* angustae, non alatae, acute triquetrae, minute pilosulae, os liguliforme semirotundatum. *Inflorescentia* terminalis angusta, fere 12–15 cm. longa, ramo infimo interdum sejuncto incluso; bracteae primariae inferae foliiformae, superiores parvae angustae; rami primarii adscendentes, non pedunculati, rami secundarii pauci, brevissimi. *Spiculae* rufobrunneae, 4 mm. longae, plerumque androgynae. *Antherae* 2½ mm. longae, anguste apiculatae. *Nux* haud 3 mm. longa, basi angusta, cetera ovoidea, versus apicem brevissime apiculatum obtuse triquetra, alba, lineis transversalibus irregularibus interruptis rufopuberulis instructa; *discus* cyathiformis, tenuis, pallide rufidulus, lobi lati, approximati, truncati, leviter et irregulariter dentati, fere ad medium nucis attingentes.

TYPUS: Pahang, Tasek Bera, S.F.N. 24042, leg. M. R. Henderson 14-10-1930 "in shallow water".

This is related to *S. Motleyi* C. B. Cl. (*S. gonocarpa* Ridl.), but is more slender, has much narrower leaves, and

the disc of the nut forms a cup nearly half the length of the nut. The shape and hairiness of the nut are almost as in *S. Motleyi*, but the upper part is less strongly angled and the apex slightly mucronate.

Diplacrum reticulatum Holtt., sp. nov. **Fig. 6.**

Habitu et foliis *D. caricino* affinis, differt internodiis brevioribus, plerumque 1–1½ cm. longis, membranis orum vaginarum firmioribus. *Spiculae feminae* 2 mm. longae, turbinatae, fere 1½ mm. latae, apice leviter acuminatae; *glumae* ovatae acutae convexae, nucem amplectentes, in

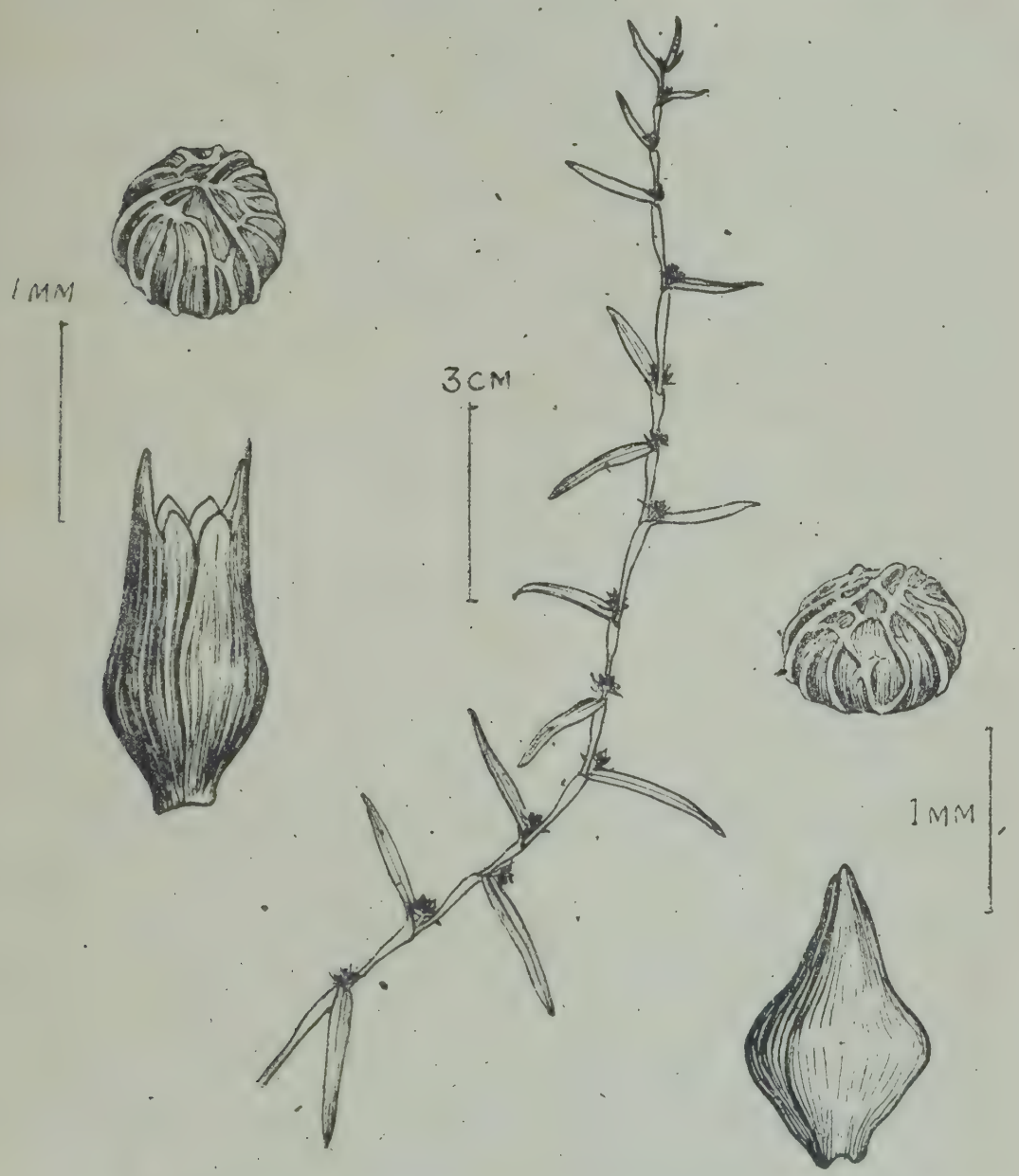


Fig. 6. **Diplacrum reticulatum**, with female spikelet and nut on right. On left, female spikelet and nut of **D. caricinum.**

sicco rubro-punctatae, venulae haud distinctae. *Nux* alba, globosa, depressa, longitudine haud 1 mm., latitudine c. 1¼ mm., tricarinata, inter carinas reticulata.

TYPUS: Pahang, Gua Tipus, Chigar Perah, S.F.N. 19411, leg. M. R. Henderson 15.10.1927; "in damp spot in lallang field". (Lallang is *Imperata cylindrica*).

This species is closely similar in habit to *D. caricinum*, but differs in its turbinate, not cylindric, female spikelets with entire glumes, and in the broader reticulate nut.

GRAMINEAE

Dendrocalamus dumosus (Ridl.) comb. nov.

Schizostachyum dumosum Ridl., Journ. Str. Br. R. Asiat. Soc. **61**: 64. 1912.

The spikelets of this species are one-flowered, and in every essential agree with the one-flowered spikelets of *D. pendulus* Ridl. (which species has either one or two-flowered spikelets). The spikelets are entirely unlike Schizostachyum.

Dendrocalamus elegans (Ridl.) comb. nov.

Schizostachyum elegans Ridl., Journ. Str. Br. R. Asiat. Soc. **73**: 146. 1916.

The spikelets of this also agree very closely with those of *D. pendulus* Ridl., having one or two florets.

Dendrocalamus sinuatus (Gamble) comb. nov.

Oxytenanthera sinuata Gamble, Ann. Calc. **7**: 71, pl. 62. 1896.

I have stated the case for the union of Oxytenanthera with Dendrocalamus in Journ. Arn. Arb. **27**: 340. 1946.

Schizostachyum Ridleyi (Gamble) comb. nov.

Ochlandra Ridleyi Gamble, Ann. Calc. **7**: 127, pl. 114. 1896.

In every respect except lodicules (of which there are 6–10), this species is extremely near to *S. latifolium* Gamble, which itself has 4 lodicules, and often basal parts of anthers winged as if in transition to lodicules. There is no evidence that *S. Ridleyi* has a large fruit, which is one of the characteristic features of Ochlandra; and Ochlandra is otherwise only known from southern India.

Spodiopogon velutinus sp. nov.

Culmi ad 300 cm. longi, procumbentes, 5–6 mm. diametro apicem versus; *folii lamina* vulgo 30 cm. longa, 4–4·5 cm. lata, apice acuminata, basi cuneata, infra molliter velutina, supra glabra, margine scabrida, basi pilis paucis longis albidis munita, costa pallida; *vagina* hirsuta vel fere glabra; *ligula* haud 1 mm. alta, glabra. *Panicula* c. 25 cm. longa, axis primarius hirsutus; ramuli ultimi tenues, glabri apicem versus dilatati, post delapsu spicularum apice crateriformes, ramulus quisque vulgo apice spiculas tres, infra apicem spiculas binas ferens; pedicelli c. 2 mm. longi; callus pilis 5–7 mm. longis patentibus instructus; *spiculae* c. 3¼ mm. longi; *glumae glabrae*, gluma inferior irregulariter 6–venulosa; *lemma inferius* latum, leviter trilobatum; *lemma superius* fere dimidio bilobatum, arista pallida, curvata, e basi lemmatis 7–8 mm. longa; *palea* brevis, profunde bilobata, ciliata; antherae 2 mm. longae; stigmata purpurea.

TYPUS: Cameron Highlands, 5,500 ft. alt., in overgrown tea estate clearing, leg. Holttum, 4.8.1946.

Chrysopogon nemoralis (Balansa) comb. nov.

Andropogon nemoralis Balansa in Morot, Journ. de Bot. 1890: 113.

Vetiveria nemoralis A. Camus, Fl. Gen. Indoch. 7: 329, 1922.

This species differs from most other species of Chrysopogon in having two sessile spikelets on the larger branches. In other respects it agrees with Chrysopogon, and is very different from the ample panicle of Vetiveria.

Rottboellia foveolata sp. nov.

Culmi fasciati, tenues, c. 50–80 cm. alti. *Laminae foliorum* ad 25 cm. longae et 6 mm. latae, basin versus sensim angustatae, supra brévissime dense pubescens; *vaginae* margine ciliatae, ad nodos breviter hirsutae; *ligula* brevis, ciliata. *Racemi* c. 6 cm. longi, c. 2 mm. lati; internodia 3 mm. longa, glabra, pedicelli spicularum paullo breviora. *Spiculae sessiles* plerumque (semper?) singulares, internodiis aequilongae, glabrae; *gluma inferior* rigida, pallida, ovata, obtusa, apice leviter retusa, carinis haud alatis, dorso omnino foveolata, foveis irregulariter quadrangularibus, in seriebus c. 6 longitudinaliter dispositis (seriebus apicem versus paucioribus), parietibus transversis spinulis minutis adscendentibus instructis; *gluma superior* tenuis, e basi ad apicem carinata, carina apicem versus anguste alata; *lemma flosculae inferioris* 2 mm. longum, latum, tenuissimum, enervatum, palea aequilonga, angustior,

2–carinata; *lemma flosculae superioris* inferiori aequilongum, palea brevior; *stamina* 3, antherae purpureae, 1½ mm. longae. *Spiculae pedicellati* 1½ mm. longae, glumis 2 tantum constatae; gluma inferior 4–venulosa, carina anguste alata; gluma superior angustior, 3–venulosa; pedicellus liberus (non cum internodio adnatus).

TYPUS: Setul. leg. Ridley 15231, March 1910.

This is nearly allied to *R. mollicoma* Hance, but differs in the quite glabrous inflorescences, and in the sharply defined cross-veins connecting the raised veins of the lower glume, forming series of irregular but distinct subquadrangular pits, whereas the cross-connections between the veins of *R. mollicoma* are formed only by the swollen bases of the hairs. The cross-walls of *R. foveolata* bear small spine-like outgrowths, often more than one.

NEW SPECIES OF EUGENIA LINN. (MYRTACEAE)

By M. R. HENDERSON, F.L.S.

The following new species of *Eugenia* are described in anticipation of a critical review of the genus in the Malay Peninsula which it is hoped will be published in the near future.

Eugenia (§ Syzygium) **atronervia** sp. nov. Fig. 1.

E. Dyeriana King et *E. Hemsleyana* King probabiliter affinis, sed foliis multo maioribus, inflorescentiis brevioribus, floribus multo maioribus differt; necnon *E. pergamentacea* King affinis, sed floribus maioribus, nervis supra non impressis differt.

A *tree* 10–12 m. tall, 10 cm. diam. 2 m. from ground, with low flattened stilt roots. *Bark* dull rufous fawn, smooth, entire, becoming slightly creviced, not pustulate or flaky; inner bark dull madder brown or purplish brown, wood dull reddish brown.

Twigs very stout, rounded or somewhat flattened, not angled, bark black or brown, smooth or somewhat ridged, not flaky.

Leaves large, narrowly elliptic, or oblong elliptic or oblong lanceolate, up to c. 36 cm. long and 16 cm. broad, apex shortly and abruptly acuminate, base shortly narrowed and more or less decurrent on petiole; upper surface drying dull fuscous brown, lower surface a warm red brown; *primary nerves* c. 17–21 pairs, somewhat raised above and quite conspicuous as are the reticulations, strongly raised and black below, the lax reticulations also raised and evident, but much less conspicuous than the primary nerves; secondaries few to none; primaries nearly straight or gently curving up to a slightly looped, well marked intramarginal nerve c. 3 mm. from leaf margin; *petiole* very stout, widely channelled above, drying black, c. 2 cm. long.

Inflorescences terminal, from 2–5·5 cm. long, stout, the largest with a 4-angled peduncle c. 2 cm. long, with 2 pairs of stout branchlets, the lower pair 7–8 mm. long, each with 3 terminal flowers, the upper pair distant from the lower by 2·5 cm., each c. 2 mm. long with three flowers each, inflorescence axis produced 5 mm. above upper branchlets and bearing 4 flowers; other inflorescences much shorter, c. 2 cm. long, with one pair of very short stout branchlets each with 3 flowers, and three terminal flowers.

Flowers sessile, buds more or less obovoid, *calyx* campanulate or obconic, rather abruptly narrowed into a

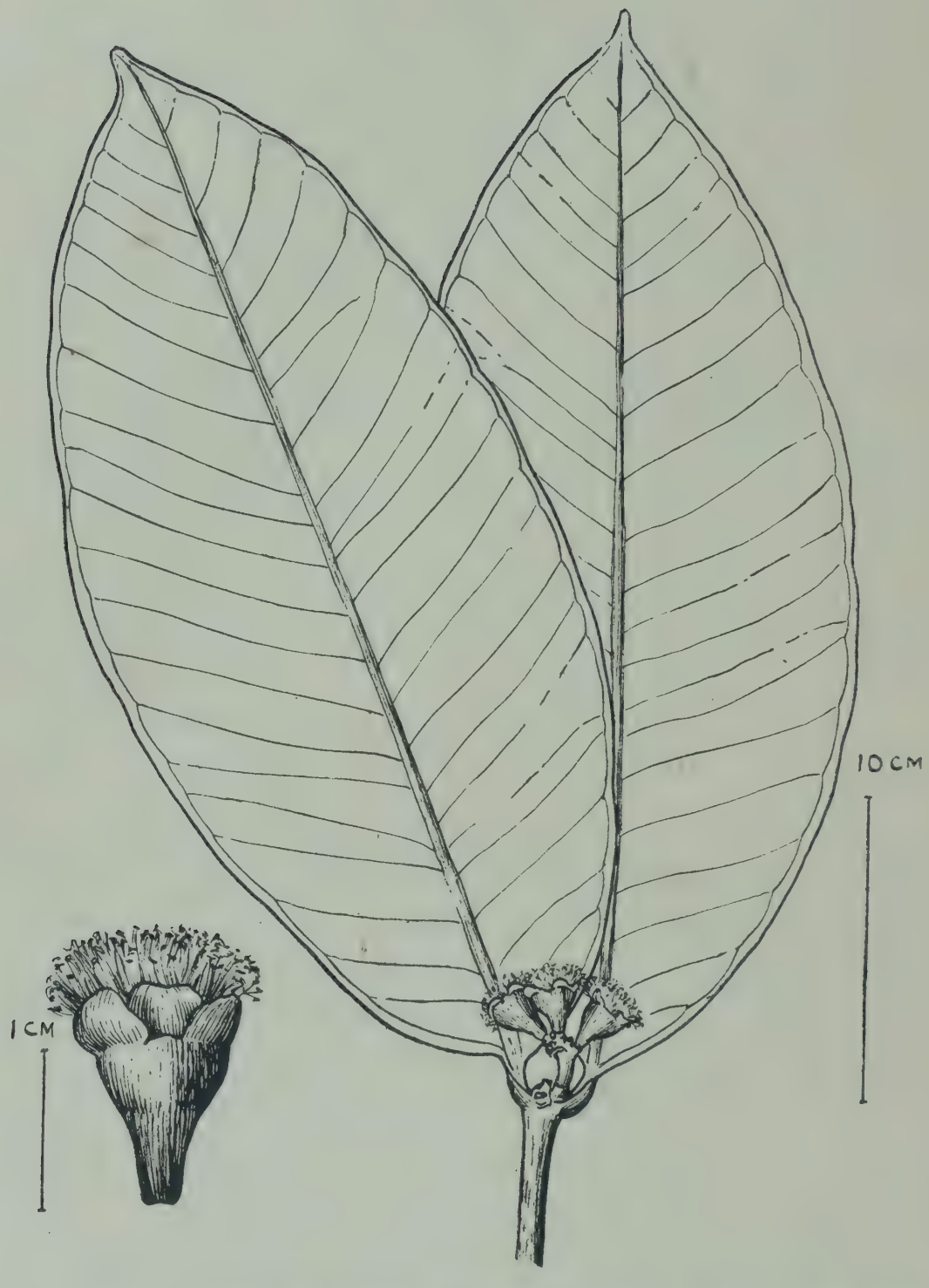


Fig. 1. **Eugenia atronervia** HENDERSON Del: CHAN YORK CHYE

very short stout pseudostalk, c. 1·8 cm. long, flower c. 2 cm. across when expanded; calyx lobes 4, persistent, broad, rounded, c. 5 mm. long and 6–7 mm. broad; *petals* free, not quickly deciduous, of the same shape and size as sepals but thinner in texture; *stamens* c. 1 cm. long; *style* c. 1·5 cm. long; *ovary* 2-celled, multiovulate.

Fruit more or less depressed globose, up to c. 4 cm. diam., apex with a rather deep excavation c. 5 mm. diam., fringed by the very short (c. 1 mm. tall) remains of calyx tube, bearing withered stamens; surface of fruit nearly black, corrugate with broken shallow vertical ridges and furrows, smooth in places; pericarp probably pulpy or fleshy, up to c. 6 mm. thick; seed 1, transversely oblong globose, c. 2·7 cm. across, testa very thick, adhering closely to cotyledons; cotyledons side by side, nearly equal, outer surface finely rugulose, inner faces conspicuously glandular pustulate, nearly plane with a shallow wide depression, sessile, plumule and radicle rather small, attached near periphery of seed.

JOHORE: Sungai Kayu Ara, Mawai-Jemaluang road, at low elevations in dry *Dryobalanops* forest, *SFN 29328* (*Corner*), TYPE collection, holotype in Herb. Singapore; 2nd mile, Mawai-Jemaluang road, *Corner s.n.*

There are two sheets of *Scortechini 2018*, Perak, sine loc., in Herb. Calcutta which may be this species, but the material is poor, one sheet consisting of incomplete leaves only, the other with flowers in young bud.

Eugenia (§ Syzygium) **Millsii** sp. nov. Fig. 2.

Arbor c. 14–17 m. alta, trunco c. 45 cm. diam. *Ramuli* teretes, crassi, cortice laevi pallide ochraceo vel fusco. *Folia* coriacea, anguste elliptica vel oblongo-elliptica, ad 15 cm. longa et 6 cm. lata, basi cuneata, apice breviter et obtuse acuta vel interdum plus minusve acuminata, minute punctata; *petiolis* 5–10 mm. longis; *venis primariis* utrinque 5–10, supra inconspicuis, in venas duas intra marginem confluentibus, in sicco venulis reticulatis inconspicuis vel obscuris. *Paniculae* terminales fasciculatae ad 7–8 cm. longae, pedunculis crassis, plus minusve tetragonis. *Flores* 3 in apice ramulorum, flos centralis sessilis, exteriori pedicellati. *Calycis* tubus campanulatus, c. 4 mm. longus, lobis 4 semiorbicularibus, persistentibus, c. 4 mm. longis et 5 mm. latis. *Petala* 4, subpersistentia, orbicularia, 6 mm. longa et 5 mm. lata, libera. *Stamina* ad 10 mm. longa, antheris oblongis vel late ellipticis, 0·5–0·6 mm. longis. *Ovarium* 2-loculare. *Fructus* ignotus.

A *tree* c. 14–17 metres tall, diam. c. 45. cm. at 2 m. from ground, trunk fluted up to c. 2 m. from ground. *Bark* smooth, brownish grey with irregular surface cracks. Twigs terete, stout, bark greyish white or pale brown, smooth, somewhat polished.

Leaves coriaceous, elliptic or oblong elliptic, up to c. 15 cm. long and 6 cm. broad, base cuneate, apex shortly and bluntly acute or sometimes more or less acuminate, drying dull brown or cinereous above, dull warm brown below, both

Fig. 2. **Eugenia Millsii** HENDERSON Del: CHAN YORK CHYE

surfaces minutely punctate; *petiole* pale coloured, 5–10 mm. long; midrib impressed above raised below; *primary nerves* 5–10 pairs, visible but not conspicuous above, very slightly raised and very slightly channelled, raised below and more or less conspicuous, the second or third pair from the base initiating a conspicuous intramarginal nerve 5–8 mm. from the leaf margin, the basal one or two pairs running up in a fainter intramarginal nerve c. 1–3 mm. from margin; secondaries a little finer and less conspicuous than primaries, reticulations practically invisible when dry.

Inflorescences terminal or from upper axils, of fascicled panicles not exceeding 7–8 cm. long, peduncles stout with pale bark, more or less 4-angled and striate. *Flowers* in

threes at ends of branchlets, the centre flower of the triads sessile, the two outers on very short stout pedicels; *calyx* tube campanulate, c. 4 mm. long, and slightly less across base of lobes, slightly contracted just below lobes, narrowed to a stout pseudostalk less than 1 mm. long; lobes 4, semiorbicular, persistent, c. 4 mm. tall and 5 mm. wide; *petals* 4, persistent for some time after the flower is fully open, orbicular, 6 mm. tall and 6·5 mm. wide, free; *stamens* numerous, longest filaments c. 10 mm. long, anthers oblong or broadly elliptic, 0·5–0·6 mm. long; *ovary* 2-celled with many ovules; *fruit* unknown.

KEDAH: Sungai Terap, near Selama, in forest on riverbank at low altitude, *SFN 35431* (*Henderson*), TYPE collection, holotype in Herb. Singapore.

Outside of calyx tube and disc pale green; sepals white or very pale green; petals and stamens white. Very conspicuous in flower and visited by many insects, principally butterflies. Flowers in May.

The affinity of this species may be with *E. densiflora* var. *angustifolia*, but it differs in being a tall tree, not a bush or bushy tree, with flowers which are smaller and of a different colour. The venation also differs considerably.

Named after the late Mr. G. R. Mills, through whose hospitality I was enabled to make collections in the neighbourhood of Selama, Kedah, in May 1938.

Eugenia (§ Syzygium) **kemamanensis** sp. nov. Fig. 3.

Arbor 8–9 m. alta. *Ramuli* teretes. *Folia* elliptica vel elliptico-lanceolata, vel obovata, apice obtuse breviter acuminata, basi rotundata vel truncata, ad 18–19 cm. longa, 8–9 cm. lata; *nervis primariis* utrinque c. 9–11, supra impressis, inter se distantibus, vena intramarginali conjunctis; petioli c. 5 mm. longi. *Inflorescentiae* e nodis defoliatis ortae, c. 4 cm. longae. *Flores* in apice ramulorum 3, pedicellis c. 2 mm. longis. *Calyx* in alabastro obconicus, c. 4–6 mm. longus, lobis 4 rotundatis. *Petala* 4, calyptrata. *Stamina* in alabastro c. 4 mm. longa. *Stylus* in alabastro c. 4–5 mm. *Fructus* plus minusve globosus, c. 1·5 cm. diam., calycis lobis persistentibus coronatus.

A *tree* c. 8–9 m. tall, bark silvery grey, even, entire, inner bark pale pink, green below surface, wood pale buff. *Twigs* terete, with smooth or somewhat striate bark, pale silvery grey when dry. *Leaves* elliptic to elliptic lanceolate, sometimes more or less obovate, apex bluntly acute or shortly bluntly acuminate, narrowed to a rounded or truncate base, up to 18–19 cm. long and 8–9 cm. broad; drying pale brown on both sides, the upper surface usually rather darker than the lower, both surfaces minutely rugose when dry; midrib deeply impressed above, strongly elevate

below; *primary nerves* distant, c. 9–11 pairs, fine and sunk above, raised below, slender but conspicuous, meeting in a well marked looped intramarginal nerve c. 0·5–1 cm. from leaf margin, with a much fainter intramarginal much nearer the margin; reticulations very faint or invisible above, very fine and lax below; *petiole* pale, rather stout, c. 5 mm. long.

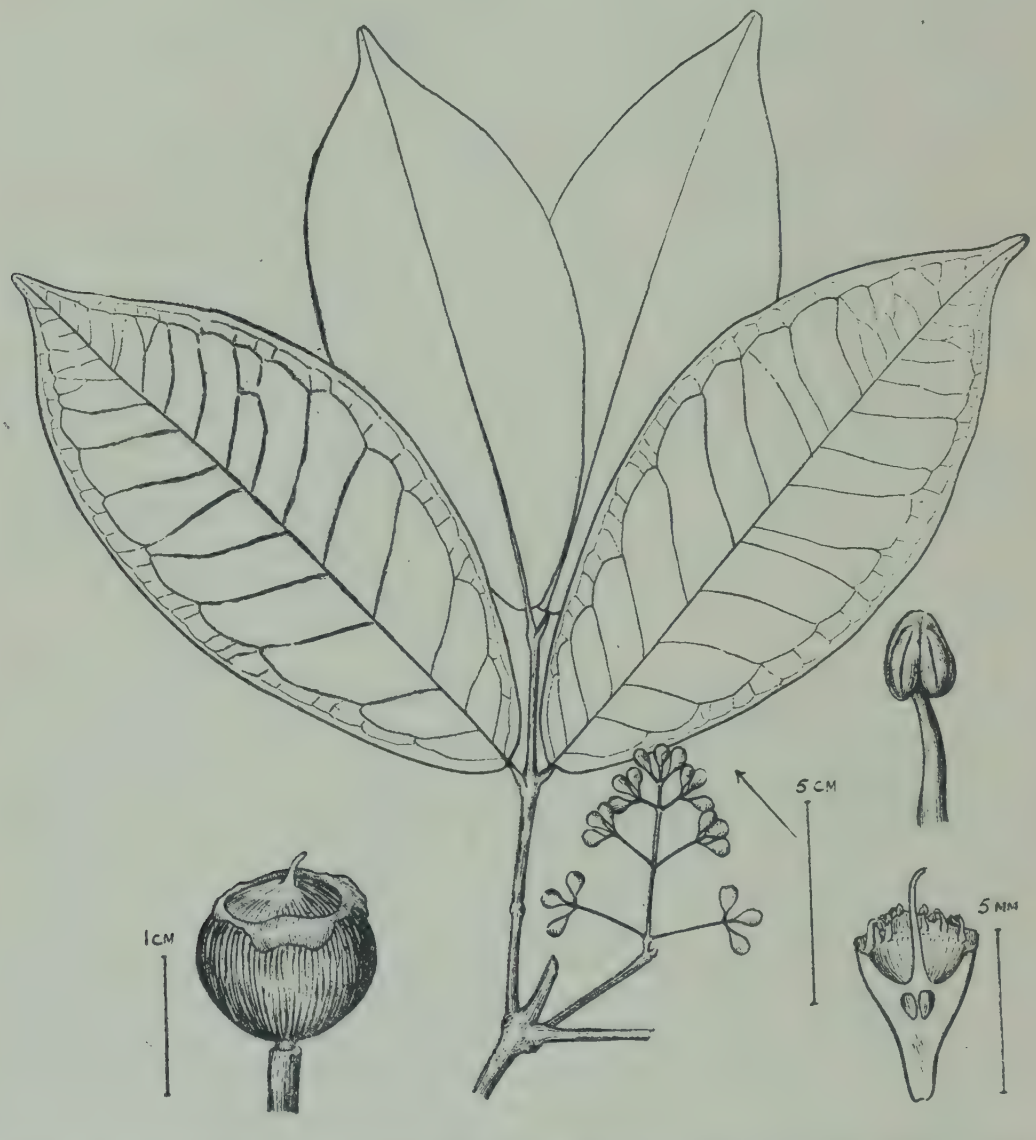


Fig. 3. **Eugenia kemamanensis** HENDERSON Del: CHAN YORK CHYE

Inflorescences from below leaves or on side twigs, practically sessile, c. 4 cm. long, rachis slender, 4-angled or compressed, with a few distant slender branchlets up to c. 2 cm. long, terminated by flowers in threes; pedicels not exceeding 2 mm. long. *Flower buds* (no opened flowers seen) c. 4–6 mm. long, obconic, tapering to a short pseudo-stalk; *calyx* lobes 4, broad, rounded, concave, c. 4–5 mm. broad and 3 mm. tall; *petals* 4, falling as a calyptra, but

separable, similar in shape to the calyx lobes but slightly larger and thinner in texture; *stamens* c. 4 mm. long; *style* c. 4–5 mm. long.

Fruit (unripe) more or less globose, crowned by the persistent sepals, c. 1·5 cm. diam., smooth or faintly vertically ridged, 1-seeded.

KEMAMAN: Ulu Ayam, Kajang, c. 500 ft., in forest, *SFN 30352* (*Corner*), TYPE collection, holotype in Herb. Singapore. Flowers and unripe fruit in November. "Fruit pale green, flushed pink on one side (unripe); calyx and pedicels often flushed pink."

Although very little material of this species has been collected, it appears to be sufficiently distinct. The minutely wrinkled surfaces give the dried leaves a curiously leathery appearance.

Fruit preserved in alcohol is globose to depressed globose, up to c. 2–2·3 cm. diam., calyx rim very wide, c. 1·4 cm. diam., apex of fruit not excavate but slightly convex with more or less persistent widely separated remains of calyx lobes. Pedicels of fruit much thicker than those of flowers. Pericarp fleshy, 1·5–2 mm. thick, the brownish testa remaining on seed when pericarp is removed. Cotyledons side by side, nearly equal, surface dark, finely rugulose and wrinkled, opposing faces nearly plane, except for a narrow radial ridge on one fitting into a corresponding groove on the other, shortly broadly stalked, radicle very small, plumule evident.

Eugenia (§ Syzygium) **Ngadimaniana** sp. nov. Fig. 4.

Arbor c. 20 m. alta. *Ramuli* teretes. *Folia* anguste elliptica vel elliptico-lanceolata vel oblongo-elliptica, ad c. 13 cm. longa et 5 cm. lata, apice abrupte acuminata, plus minusve caudato-acuminata, basi in petiolum longiter angustata, costa media supra impressa, subtus elevata; *venis primariis* utrinque c. 7–13, 5–10 mm. inter se distantibus, supra haud conspicuis, subtus teneribus, prominulis, in venam intramarginalem inconspicuam conjunctis, venis secundariis et reticulationibus supra obscuris, venis secundariis subtus teneribus. *Petioli* 1–1·5 cm. longi. *Inflorescentiae* terminales vel ex axillis foliorum superiorum, paniculatae, ad c. 9 cm. longae, pedunculatae. *Flores* sessiles, bracteolis oblongo-lanceolatis subacutis, subpersistentibus, alabastris obovoideis c. 6–6·5 mm. longis. *Calyx* obconicus, 3–4 mm. longus, lobis 5, c. 2 mm. latis et 0.2 mm. altis, acutis vel subacutis. *Petala* calyptratim decidua. *Stamina* ad c. 8 mm. longa, antheris parvis, c. 0·2 mm. diam., glandula inconspicua. *Ovarium* biloculare. *Bacca* ovoidea ad obovoidea, c. 2 cm. longa et 1·25 cm. lata, apice umbilico 2–3 mm. diam. calycis lobis persistentibus coronato.

A *tree* c. 20 metres tall. *Bark* pale brown or fawn brown, more or less smooth with fine irregular cracks, scaling in occasional irregular pieces, not papery flaky, with irregular longitudinal pits or dimples; inner bark thick, c. 1 cm., dull red or reddish brown. *Twigs* terete, youngest with smooth or slightly pustulate dark brown or reddish brown or greyish brown bark, older twigs with reddish bark longitudinally cracked and sometimes slightly flaky. *Leaves* thinly coriaceous, from c. 6 cm. long and 3·5 cm. broad or occasionally smaller to c. 13 cm. × 5 cm., narrowly elliptic

Fig. 4. **Eugenia Ngadimaniana** HENDERSON Del: CHAN YORK CHYE

or elliptic lanceolate or oblong elliptic, apex abruptly acuminate, more or less caudate acuminate, acumen 1–1·5 cm. long, base long narrowed on to petiole; upper surface when dry smooth and often shining, pale brown to dark brown, minutely and often obscurely pitted, lower surface usually paler, with minute slightly raised gland dots; midrib impressed above in a dark coloured channel, raised below; *primary nerves* c. 7–13 pairs, 5–10 mm. distant, slender but distinguishable from secondaries, sunk in narrow channels and not conspicuous above, slightly elevate below,

meeting in án inconspicuous intramarginal nerve 1–2 mm. from leaf margin; secondaries and reticulations almost invisible above,secondaries below nearly as conspicuous as primaries but distinguishable from them, reticulations below usually faint; petiole slender, 1–1·5 cm. long, reddish brown, finely wrinkled, channelled above.

Panicles terminal or from upper axils, solitary or more usually several from each axil or branchlet ends, up to c. 9 cm. long, peduncle 2–5 cm. long, slightly angled or compressed, bark pale, greenish brown, longitudinally wrinkled; branchlets 2–4 pairs, the lowest up to c. 2 cm. long, the upper shorter, almost horizontal or curving upwards, *flowers* crowded at branchlet ends or at end of secondary branchlets c. 3–6 mm. long, sessile, bracteoles oblong lanceolate, subacute, c. 1·5 mm. long, subpersistent; buds more or less obovoid, c. 6–6·5 mm. long. *Calyx* obconic, 3–4 mm. long, c 3·5–4 mm. across mouth, without pseudostalk, lobes 5, shallow, broad, acute or subacute, inconspicuous, c. 2 mm. wide and 0·5 mm. tall. *Petals* falling in a calyptra but not agglutinated, more or less orbicular, c. 3 mm. diam., conspicuously gland dotted. *Stamens* numerous, filaments slender, terete, up to c. 8 mm. long, anthers very small, c. 0·2 mm. diam,, connective gland inconspicuous. *Ovary* 2-celled with several ovules in each cell.

Fruit when dry ovoid to obovoid, c. 2 cm. long and 1·25 cm. wide, black, finely wrinkled, apical umbilicus shallow, 2–3 mm. diam., its margin with the persistent hardly enlarged calyx lobes; fresh fruit when ripe dark green slightly flushed dull purplish red at apex, obscurely ridged vertically, oblong obovoid, apical umbilicus shallow, c. 3 mm. diam., bearing the 5 small not enlarged broadly triangular acute incurved calyx lobes and style base; pericarp pithy leathery, c. 2 mm. thick; seed 1, more or less oblong, testa thick, whitish pink, brittle crustaceous; cotyledons superposed, pale yellowish white, glistening, more or less equal, inner faces plane or slightly concave, sessile.

JOHORE: Sungai Kayu, Mawai-Jemaluang road, in swampy forest, *SFN 32152* (*Kiah*).

SINGAPORE: Bukit Timah Reserve, altitude under 500 ft., *SFN 36129* (*Ngadiman*), Tree No. 392, TYPE collection, holotype in Herb. Singapore; same locality, *SFN 37012, 37020* (*Ngadiman*).

Flowers have been collected in September and October, fruits in November and December.

Eugenia (§ Syzygium) **Kiahii** sp. nov. Fig. 5.

Arbor c. 12 m. alta. *Ramuli* teretes, crassi, cortice laevi. *Folia* valde coriacea, ovata vel orbicularia, vel late elliptica vel elliptico-oblonga ad c. 10 cm. longa et 9 cm. lata, basi

breviter cuneata vel rotundata ad petiolum brevissime et abrupte attenuata, apice rotundata vel breve obtuseque acuta vel apiculata; petiolis c. 1 cm. longis; *nervis primariis* tenuibus, utrinque c. 7–10, in venam arcuatim e margine 2–5 mm. distantem confluentibus. *Inflorescentiae* terminales, pedunculis c. 2·5 cm. longis. *Flores* in apice ramulorum dense dispositi, alabastris obovoideis c. 7–8 mm. longis. *Calycis* tubus anguste campanulatus in stipitem plus minusve abrupte attenuatus, c. 5–6 mm. longus, lobis 5,

Fig. 5. **Eugenia Kiahii** HENDERSON Del: CHAN YORK CHYE

triangulo-ovatis, obtusis, c. 1 mm. altis. *Petala* calyptratim decidua. *Stamina* 3·5–4 mm. longa, antheris globosis vel late triangulo-ovatis, c. 0·4 mm. diam. *Ovarium* 1–2–loculare, multiovulatum. *Fructus* ignotus.

A *tree* c. 12 metres tall. *Twigs* stout, terete, bark smooth, sometimes polished, grey brown or pale brown or greyish white.

Leaves very coriaceous, ovate or orbicular, or broadly ovate oblong or broadly elliptic or elliptic oblong, up to c. 10 cm. long and 9 cm. broad, base very shortly cuneate, or rounded and very shortly and abruptly narrowed to petiole, apex rounded or shortly and bluntly acute or apiculate; both surfaces drying pale reddish brown or the upper surface blackish brown and the lower dull warm brown, petiole c. 1 cm. long; midrib impressed above, elevate below; *primary nerves* fine, raised on both surfaces, slightly less conspicuous above than below, about 7–10 pairs, meeting in an intramarginal loop 3–5 mm. from leaf margin, secondaries and reticulations raised on both surfaces, almost as distinct as primaries.

Inflorescences short and dense, terminal, on stout peduncles c. 2·5 cm. long; peduncles and rachis as stout as twigs, more or less compressed, secondary branchlets also stout and angled, c. 1·5 cm. long, the flowers crowded at their apices or on tertiary branchlets c. 3 mm. long. *Flower* buds obovoid, c. 7–8 mm. long, *calyx* narrowly campanulate, narrowed rather abruptly into a stout pseudostalk which is rather variable in length; length of calyx tube including pseudostalk 5–6 mm., mouth with 5 rather distant triangular ovate blunt lobes c. 1 mm. tall. *Petals* calyptrate, leathery. *Stamens* 3·5–4 mm. long, anthers globose to broadly triangular ovate, c. 0·4 mm. diam., connective gland dark brown, conspicuous, finely gland dotted. *Ovary* 1–2–locular, multiovulate. *Fruit* unknown.

JOHORE: Sungai Kayu, Mawai-Jemaluang road, *SFN 32036* (*Kiah*), TYPE collection, holotype in Herb. Singapore; Sungai Kayu, in swampy forest, *SFN 29400* (*Corner*).

Eugenia (§ Syzygium) **Haniffii** sp. nov. Fig. 6.

Arbor 15 m. alta, ramulis teretis, fuscis; *foliis* oblongis vel elliptico-oblongis, in sicco olivaceis vel fuscis, basi cuneatis, apice acuminatis, ad 13 cm. longis et 5 cm. latis; *venis primariis* utrinque 25–40, tenuibus, vena intramarginali vix distincta; petiolis c. 5–7 mm. longis. *Paniculae* terminales, densae, ad 8 cm. longae, vulgo breviores, ramis primariis crassis, ramulis ultimis tenuioribus, plus minusve tetragonis. *Flores* 3 in apice ramulorum, exteriori pedicellati, pedicellis ad 0·8 mm. longis, flos centralis sessilis.

Calycis tubus anguste infundibuliformis, basi breve stipitatus, ad 4–6 mm. longus; lobis 4, conspicuis, persistentibus, c. 1·5 mm. altis et 2·5 mm. latis. *Petala* 4, membranacea, libera, subpersistentia. *Stamina* 9–12 mm. longa, stylus subaequilongus. *Ovarium* 2-loculare. *Fructus* globosi, c. 1·5 cm. diam., apice calycis margine et sepalis persistentibus coronati. *Semen* 1, globosum, cotyledonibus subaequalibus.

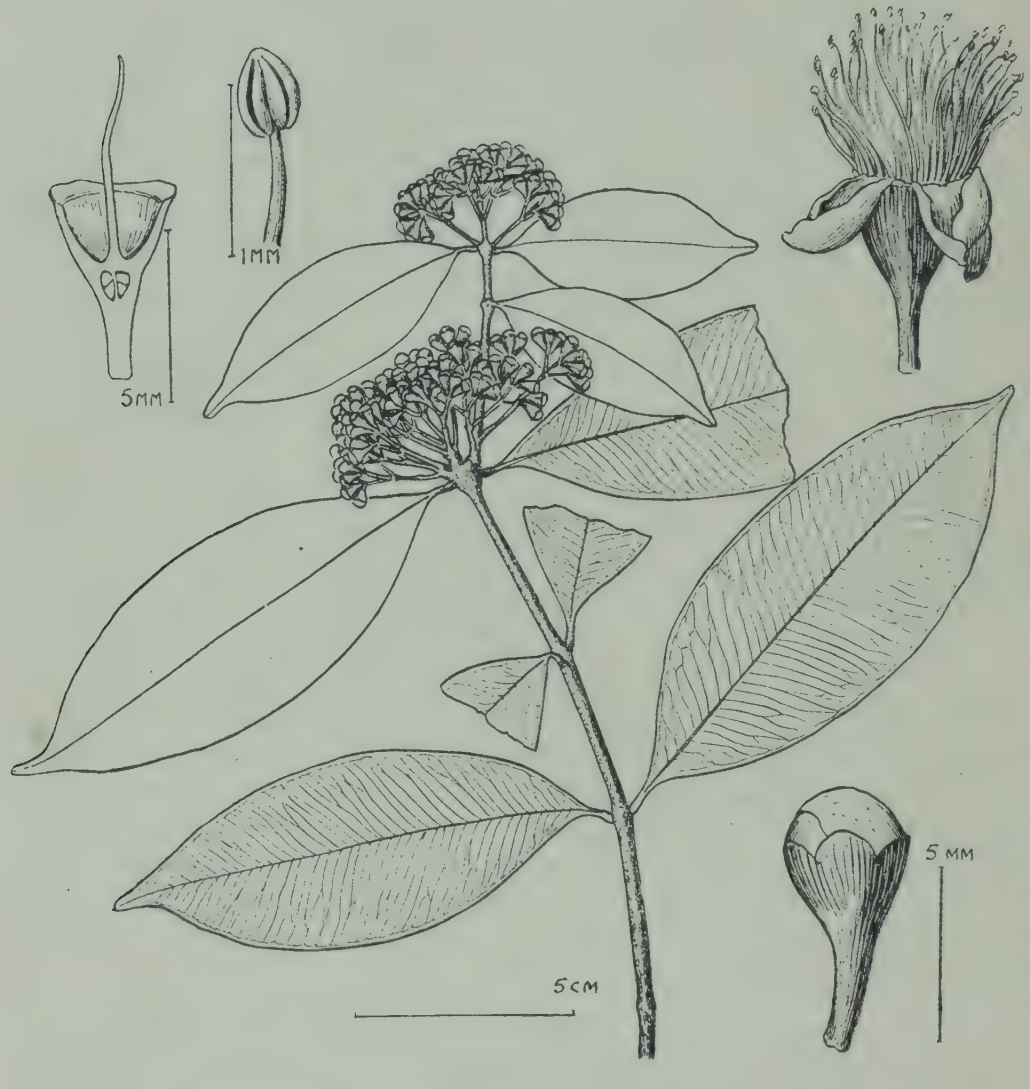


Fig. 6. **Eugenia Haniffii** HENDERSON Del: CHAN YORK CHYE

A tree 12–15 metres tall. *Twigs* rather stout, terete, their bark reddish brown, to the naked eye practically smooth, under a lens cracking longitudinally.

Leaves chartaceous, drying either greenish brown (recently collected specimens) or dull grey brown above and pale dull grey brown below (in older specimens), oblong to elliptic oblong, base cuneate, apex rather abruptly acuminate, up to c. 13 cm. long and 5 cm. broad; *petiole* slender, c. 5–7 mm. long, dark coloured when dry, narrowly channelled above; *midrib* sunk above, prominent below; *primary*

nerves fine, not more prominent than secondaries and hardly distinguishable from them, about 25–40 pairs, raised above and below, meeting in an inconspicuous intramarginal nerve c. 2–4 mm. from leaf margin, with an even more inconspicuous secondary intramarginal c. 1 mm. from margin; leaf margin slightly revolute when dry.

Panicles terminal, densely flowered, often much contracted, not exceeding 8 cm. long and usually much shorter, primary branches stout, with reddish brown bark as on twigs, ultimate branchlets finer, more or less 4-angled, with dark striate bark. *Flowers* in threes at ends of branchlets, the two outer on pedicels c. 0·8 mm. long, the central flower sessile. *Calyx* narrowly funnel shaped in bud, c. 4–6 mm. long including lobes, gradually narrowed to a slender pseudostalk, the centre flower of the triads with a slightly longer pseudostalk than the outers, calyx tube finely longitudinally striate and black when dry; lobes 4, conspicuous, broad, persistent after anthesis, c. 1·5 mm. high and 2·5 mm. wide, rather thick in texture with membranous edges. *Petals* 4, membranous, quite free and falling separately, persistent for some time after anthesis. *Stamens* 9–12 mm. long, *style* about as long. *Ovary* 2–locular with many ovules.

Fruit globose or slightly depressed globose, c. 1·5 cm. diam., (?not fully ripe), with shallow inconspicuous vertical ridges, crowned by calyx limb and persistent sepals; pericarp thin, tough; seed 1, globose, the cotyledons more or less equal, attached to hypocotyle near centre of opposing faces.

PENANG: Penara Bukit, c. 1,000 ft., *Curtis 794*, TYPE collection, holotype in Herb. Singapore. (One sheet of this collection is written up in King's hand as *E. densiflora* Duthie).

SELANGOR: 20th mile, Ginting Simpah, *Forest Dept. FMS 12860;* 23rd mile, Ginting Simpah, *Forest Dept. FMS 13383.*

Probably allied to *E. oblata* Roxb. from which it differs in the smaller flowers, more deeply lobed calyx, denser inflorescence, thinner leaves with finer and closer venation and the intramarginal nerve farther from the leaf margin. Also allied to *E. longiflora* F. Vill.

Named after the late Mohamed Haniff, who was for many years attached to the Gardens Department of the Straits Settlements.

Eugenia (§ Syzygium) **camptophylla** sp. nov. Fig. 7.

E. inophylla Roxb. affinis sed lobis calycis maioribus, foliis angustioribus, venis paucioribus; necnon *E. oblata* Roxb. affinis sed floribus angustioribus et minoribus, foliis multo angustioribus, venis et venulis minus prominentibus.

A *tree* 12–15 metres tall, stem 20–23 cm. diam. (ex Kunstler). *Twigs* smooth, terete, bark dull brown; *leaves* lanceolate or narrowly elliptic lanceolate, or somewhat ovate-lanceolate, up to c. 13 cm. long and 4 cm. broad, apex long acuminate, often folded or bent sideways when dry, base long narrowed and somewhat decurrent on petiole; upper surface drying blackish brown, lower surface dull reddish brown; midrib sunk above in a narrow channel, raised below; *primary nerves* about 20 pairs, very faint above, slightly raised and channelled, very slender and inconspicuous below, slightly raised, meeting in a very fine intramarginal nerve 1–2 mm. from the recurved leaf margin; secondaries and reticulations almost invisible above, a little less conspicuous than primaries below; *petiole* up to c. 1 cm. long, slender, black, wrinkled, deeply channelled above.

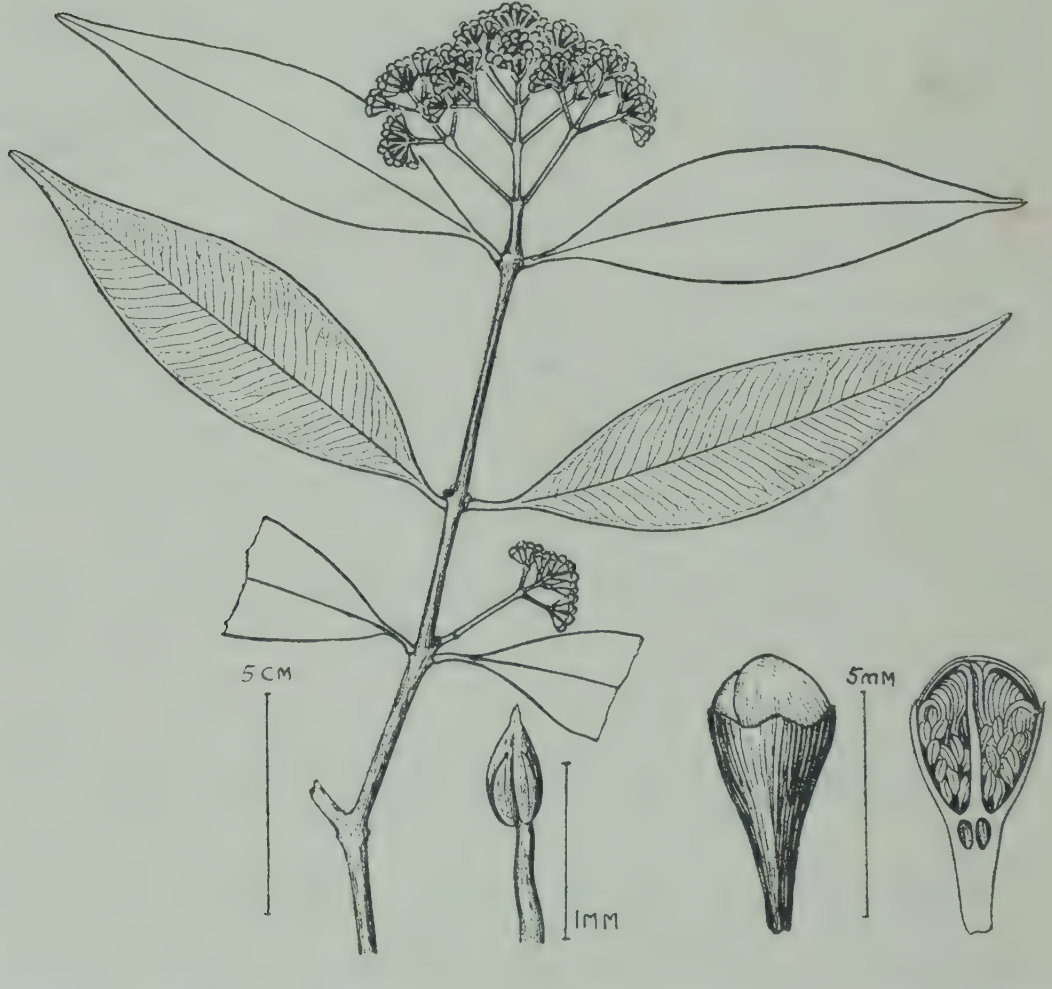


Fig. 7. **Eugenia camptophylla** HENDERSON Del: CHAN YORK CHYE

Inflorescence a spreading panicle, or several together, terminal or from upper one or two axils, on a peduncle up to c. 4 cm. long, but usually much shorter and not exceeding c. 1 cm., peduncle and inflorescence branches rather slender,

strongly angled, with striate bark, inflorescence up to c. 9·5 cm. long and 6 cm. across. *Flowers* densely crowded at ends of branchlets, c. 1 cm. long, sessile, bracteoles small and inconspicuous, soon falling; *calyx* in bud funnel shaped, c. 6 mm. long and 3 mm. across mouth, tapering gradually from apex to base, the pseudostalk c. 2–3 mm. long, but not sharply marked off, calyx mouth with 5 broad shallow inconspicuous blunt or subacute lobes c. 1·25 mm. wide and 0·5 mm. high, but variable in size, persisting for some time after the flower has opened and the stamens fallen; *petals* probably falling as a calyptra but easily separable, more or less orbicular, c. 3 mm. diam; *stamens* numerous, filaments slender, up to c. 8 mm. long, anthers triangular ovate, c. 0·5 mm. long, connective produced beyond anthers into a narrow triangular gland; *style* considerably stouter than filaments, c. 6 mm. long. *Fruit* unknown.

PERAK: Gopeng, 500–800 ft., open jungle in hilly locality, *Kunstler 5994*, TYPE collection, holotype in Herb. Calcutta.

Known only from the type collection of which I have seen three sheets in Herb. Calcutta and two in Herb. Dehra Dun.

The extension of the connective in the stamens beyond the anthers into a narrow triangular gland seems to be rare in Eugenia and has been seen otherwise only in an unidentified species of unknown origin cultivated in the Botanic Gardens, Singapore.

Eugenia (§ Syzygium) **Brantiana** sp. nov. Fig. 8.

Frutex vel *arbor* parva; ramulis teretibus, cortice laevi; *foliis* oblongo-ellipticis ad ovatis, ad c. 13 cm. longis et 5 cm.latis, apice longe acuminatis, acumine ad 1–2 cm. longo, basi cuneatis ad petiolum attenuatis, petiolo c. 0·5 cm. longo; costa supra canaliculata, subtus elevata, *venis primariis* utrinque ad c. 15, supra haud conspicuis, subtus leviter elevatis submanifestis, in venam intramarginalem inconspicuam 1–2 mm. a margine distantem confluentibus; *inflorescentiis* terminalibus vel ex axillis foliorum superiorum, paniculatis, subsessilibus vel pedunculatis, ad c. 9 cm. longis, ramis primariis ad c. 2 cm. longis, floribus sessilibus, confertis; alabastris c. 1 cm. longis; *calycis* tubo c. 7–8 mm. longo, apice c. 5 mm. lato, basi stipitato (stipite c. 2–3 mm. longo), lobis inconspicuis, c. 0·75 mm. altis et 2–2·5 mm. latis, glandulosis; *staminibus* numerosissimis, 15–16 mm. longis, antheris oblongo-ovatis, 0·5–0·75 mm. longis, connectivo conspicue glanduloso-mucronato; *fructibus* ignotis.

A *shrub* or small *bushy tree*. *Branchlets* terete, bark smooth, grey brown to reddish. *Leaves* thinly coriaceous, oblong elliptic to ovate, up to c. 13 cm. long and 5 cm. broad,

Fig. 8. **Eugenia Brantiana** HENDERSON Del: CHAN YORK CHYE

apex long acuminate, acumen 1–2 cm. long, base cuneate and narrowed on to petiole, upper surface drying greenish to reddish brown, minutely gland dotted, lower surface greenish to brownish, paler than upper, minutely gland dotted; midrib shallowly impressed above, elevate below; *primary nerves* up to about 15 pairs, slender and not conspicuous above, pale and very slightly raised, slightly raised and slender below, a little more conspicuous than secondaries; secondaries and reticulations usually obscure above, visible below and almost as conspicuous as primaries; intramarginal nerve slender and inconspicuous, 1–2 mm. from margin; *petiole* c. 0·5 cm. long, drying dark red brown.

Inflorescence terminal or from upper axils, paniculate, up to c. 9 cm. long, nearly sessile or peduncles up to c. 3 cm.

long, primary branchlets up to c. 2 cm. long, flowers clustered either at ends of primary branchlets or of secondary branchlets c. 0·5–1 cm. long; bark of inflorescence reddish brown to greenish brown, peduncle more or less terete, branchlets compressed or more or less 4–angled; bracteoles very small and fugacious. *Flowers* sessile, buds c. 1 cm. long, *calyx* c. 7–8 mm. long, c. 5 mm. across mouth, very finely wrinkled, narrowed at base into a rather stout pseudostalk 2–3 mm. long, lobes broad, shallow, inconspicuous, c. 0·75 mm. high and 2–2·5 mm. wide, pellucidly gland dotted; *petals* with pellucid gland dots, falling in a calyptra; *stamens* very numerous, 15–16 mm. long, anthers ovate oblong, 0·5–0·75 mm. long, connective gland brown, conspicuous; *style* 12–13 mm. long; *ovary* 2-celled with several ovules in each cell; *fruit* unknown.

JOHORE: Sungai Pontian Besar, common on the river bank in the *Terminalia-Pandanus* zone, *SFN 36754* (*Henderson*), TYPE collection, holotype in Herb. Singapore; same locality, *SFN 36956* (*Corner & Henderson*).

Named after the late Mr. R. V. Brant, sometime Assistant Adviser, Pontian.

Allied to *E. inophylla* Roxb., but differing in the paler bark of the twigs, the paler leaves when dry, the much longer stamens, and in being a bush or small bushy tree of tidal rivers.

Eugenia (§ Syzygium) **pseudosyzygioides** sp. nov. Fig. 9.

E. cymosa Wight valde affinis, sed cortice trunci pallide laevi, cortice ramulorum pallidiore, stipite calycis longiore, tubo calycis infundibuliformis, in sicco pustulato et rugoso, petalis vulgo calyptratis differt.

Arbor 18–24 m. alta, c. 25–60 cm. diam. *Ramuli* teretes, graciles, laeves. *Folia* ovata, ovato-lanceolata ad oblongo-lanceolata, vel anguste elliptica, apice caudato-acuminata, basi cuneata, 4 cm. × 2 cm. ad 9·5 cm. × 4·5 cm., *petiolis* gracilibus, 3–5 mm. longis; *nervis primariis* numerosis. *Paniculae* terminales et axillares ad 7 cm. longae, vulgo 4–5 cm. longae. *Flores* sessiles, in apice ramulorum brevissimorum ternati vel pseudoumbellati; alabastris c. 5–6 mm. longis; *calycis* tubo infundibuliforme, breviter stipitato, lobis 5, c. 0·5 mm. latis et 0·3 mm. longis. *Petala* vulgo calyptrata, ?vel interdum libera. *Stamina* ad 5–6 mm. longa, antheris oblongis, c. 0·4 mm. longis. *Stylus* c. 5–6 mm. longus. *Ovarium* 2-loculare. *Fructus* ignotus.

A *tree* 18–24 metres tall, c. 25–60 cm. diam. 2 metres from ground, trunk cylindric. *Bark* dull greyish, pallid, smooth, entire, faintly marked with transverse ridges but even in other places; inner bark thin, greyish brown; wood

Fig. 9. **Eugenia pseudosyzygioides** HENDERSON Del: CHAN YORK CHYE.

pallid buff, darkening and turning brownish drab on exposure. *Twigs* slender, terete, their bark smooth or finely longitudinally cracked, the youngest twigs brown or reddish brown, the older ones whitey-brown to pale grey.

Leaves thinly coriaceous, ovate, ovate lanceolate to oblong lanceolate, or narrowly elliptic, apex caudate acuminate, the acumen up to 2 cm. long, base cuneate, variable in size from c. 4 cm. long and 2 cm. broad to 9·5 cm. long and 4·5 cm. broad; upper surface drying dull brown to lead colour, lower surface usually paler, brown to reddish brown; *petiole* slender, deeply and narrowly channelled above, wrinkled and pustulate below, dark red brown, 3–5 mm. long; midrib narrowly channelled above, raised below, more or less pustulate, especially towards petiole; *primary nerves* numerous, close and parallel, not distinguishable from secondaries, reticulations almost as conspicuous, all raised on upper surface and more strongly raised on lower surface, sometimes much darker than surrounding leaf surface; intramarginal vein very close to and partly hidden by the revolute margin; upper surface minutely punctate, lower surface sparsely black dotted.

Panicles axillary and terminal, up to c. 7 cm. long but usually 4–5 cm. long, peduncles and branches slender, spreading, compressed or angled, with dark, longitudinally wrinkled, often pustulate bark. *Flowers* sessile in threes at ends of very short branchlets, or these branchlets so reduced that the flowers appear umbellately arranged; flower buds c. 5–6 mm. long; *calyx tube* funnel shaped, usually more or less pustulate, narrowing to a slender pseudostalk, mouth with 5 shallow rounded broad lobes c. 0·5 mm. wide and 0·3 mm. high. *Petals* calyptrate, apparently occasionally free, orbicular. *Stamens* up to c. 5–6 mm. long, anthers oblong, c. 0·4 mm. long with conspicuous brown gland on connective. *Style* rather stout, 5–6 mm. long. *Ovary* 2-celled. *Fruit* unknown.

KEMAMAN: Bukit Kajang, 500 ft., *SFN 30451* (*Corner*), TYPE collection, holotype in Herb. Singapore, *SFN 30421* (*Corner*), *SFN 30497* (*Corner*). Flowers in November.

PERAK: Larut, within 100 ft., in open old jungle in low ground, *Kunstler 3422*, "leaves light green, very glossy", flowers in October.

This species is evidently closely allied to *E. cymosa* from which sterile specimens cannot be distinguished with certainty in the Herbarium, except for the usually narrower, more oblong leaves. In the field, however, the trees are quite distinct, *E. pseudosyzygioides* having a smooth pale bark, while *E. cymosa* has a dark red or fuscous brown bark which is more or less fissured and flaky.

Most of the specimens of *E. pseudosyzygioides* on which flowers at the proper stage are to be found, have calyptrate petals, whereas in most of the specimens of *E. cymosa* in Herb. Singapore the petals are free. Koorders & Valeton and King describe them as free, Gagnepain as calyptrate. It is not a very reliable character, for both free and calyptrate petals may be found on the same individual.

Eugenia (§ Syzygium) **praestigiosa** sp. nov. Fig. 10.

?Arbor. *Ramuli* teretes, laeves. *Folia* coriacea, oblongo-lanceolata vel oblongo-elliptica, ad c. 9 cm. longa et 3·75 cm. lata, apice acuminata, basi attenuata, supra punctata, subtus pustulato-punctata, punctis nigris densis; *nervis primariis* tenuibus utrinque 12–15, in venam submarginalem a margine c. 1 mm. distantem conjunctis, petiolis ad 1 cm. longis. *Inflorescentiae* fasciculatae, terminales vel axillares, spiciformes vel paniculatae pauci-ramosae, ad 4·5 cm. longae. *Flores* sessiles ad apice ramulorum conferti. *Calycis tubus* in alabastro c. 6–6·5 mm. longus et 3·5–4 mm. latus, anguste infundibuliformis, lobis 4 rotundatis persistentibus c. 2 mm.

Fig. 10. **Eugenia praestigiosa** HENDERSON Del: CHAN YORK CHYE

altis et 3 mm. latis. *Petala* 4, libera, reflexa, rotunda, c. 5 mm. diam., glandulosa. *Stamina* ad 9–10 mm. longa, antheris oblongis, 0·7–0·8 mm. longis. *Stylus* c. 8 mm. longus. *Ovarium* 2-loculare. *Fructus* ignotus.

?A tree, *twigs* terete, their bark smooth, not polished, dark brown or dark reddish brown, in places pale grey and finely cracked. *Leaves* coriaceous, oblong-lanceolate or oblong-elliptic, up to c. 9 cm. long and 3·75 cm. broad, apex acuminate, base narrowed, upper surface drying olivaceous brown or reddish brown, slightly shining, minutely and densely punctate, lower surface paler and duller, minutely and densely black pustulate-dotted; midrib sunk above, raised below and pustulate except at apex, and longitudinally wrinkled; *primary nerves* about 12–15 pairs, very fine and slender above, slightly raised, fine below but rather more conspicuous than on upper surface, raised, meeting in a fine intramarginal nerve c. 1 mm. from recurved leaf edge; secondary veins only partially visible above, reticulations very obscure or invisible, secondaries and reticulations fine and raised below but distinctly less conspicuous than primaries; petiole c. 1 cm. long, rather slender, deeply channelled above, drying black.

Inflorescences crowded, terminal or in upper axils, spiciform or paniculate with few branches, up to c. 4·5 cm. long, rachis compressed or angled with strongly striate pale brown bark. *Flowers* sessile, crowded at or near ends of inflorescence branches. *Calyx* in bud c. 6–6·5 mm. long and c. 3·5–4 mm. across mouth, obconic or campanulate and tapering gradually to base, somewhat striate, pseudostalk very short, not evident, rather abruptly expanded at the mouth into 4 deep rounded persistent lobes c. 2 mm. high and 3 mm. across. *Petals* 4, free, reflexed after flower opens, more or less orbicular, c. 5 mm. across, gland dotted. *Stamens* numerous, filaments slender, up to c. 9–10 mm. long, anthers oblong, c. 0·7–0·8 mm. long, connective gland obscure or absent. *Style* rather stout, tapering to apex, c. 8 mm. long. *Ovary* 2-celled with several or many ovules in each cell. *Fruit* unknown.

PERAK: sine loc., *Scortechini sine num.*, TYPE collection, holotype in Herb. Calcutta.

Unfortunately no indication of locality and no date or number is given on any of the five sheets of this collection in Herb. Calcutta.

This plant appears quite distinct from any other *Eugenia* described from the Malay Peninsula. The inflorescences recall those of *E. rugosa* Merr., but the flowers and foliage are quite different. The flowers resemble those of *E. longiflora* F. Vill., but are shorter, with more conspicuous petals, and the inflorescence and leaves differ considerably.

The plant is distinctive amongst the Peninsular species in its short crowded inflorescences, and the crowded flowers with conspicuous calyx lobes and petals.

Included in the same cover in Herb. Calcutta was a sheet of *Forbes 2985* from Sumatra. This is in fruit only and at first sight appears very close to *E. praestigiosa*, but it differs in having pale yellow and somewhat polished twigs, thinner leaves not punctate above, with shorter petioles. The inflorescences are very like those of *E. praestigiosa*. The fruit of Forbes' plant is smooth and oblong without persistent calyx lobes and is of the type associated with the clavate or peg-shaped flowers of such species as *E. attenuata* K. & V. The fruit of *E. praestigiosa* is more likely to resemble that of *E. longiflora*, probably with persistent calyx lobes.

Eugenia (§ Syzygium) **quadribracteata** sp. nov. Fig. 11.

Arbor c. 20 m. alta, glabra. *Folia* vulgo elliptico-oblonga, ad 25 cm. longa et 10 cm. lata, apice breviter obtuse acuminata vel acuta, basi breviter acuminata et in petiolum breviter decurrentia, utrinque dense punctata; *venis primariis* tenuibus, numerosis, utrinque c. 60, vena intramarginali tenui distincta conjunctis; *petiolis* crassis c. 1–1·3 cm. longis. *Inflorescentiae* terminales vel interdum axillares, ad 9 cm. longae. *Flores* sessiles in apice ramulorum dense capitulati, bracteolis 4 persistentibus instructi. *Calyx* in alabastro plus minusve globosus, post anthesis obconicus, c. 3–4 mm. longus et 4–5 mm. latus, lobis 5, late triangularis, rotundatis. *Petala* calyptrata. *Stamina* c. 5–6 mm. longa, stylus aequilongus. *Fructus* immaturus plus minusve globosus, 5–6 mm. diam., calycis margine coronatus.

A *tree* c. 20 metres tall. *Twigs* stout, terete, bark smooth or creviced or slightly flaky, brown or greyish brown, the youngest twigs with quite smooth dark warm brown bark. *Leaves* generally oblong elliptic, occasionally tending to be ovate, up to c. 25 cm. long and 10 cm. broad, but generally rather smaller, apex shortly bluntly acuminate or acute, base shortly narrowed and slightly decurrent on petiole; *petiole* stout, drying black, c. 1–1·3 cm. long; *primary nerves* very numerous and close together, hardly distinguishable from secondaries, up to about 60 pairs, fine but distinctly elevate above and below, secondary nerves and reticulations little less conspicuous than primaries; intramarginal nerve as distinct as primaries, c. 2–3 mm. from the revolute leaf margin; upper surface drying dull greyish brown, densely and minutely punctate, lower surface rather warmer brown or reddish brown, also densely and minutely punctate.

Inflorescences terminal or occasionally axillary, sometimes fasciculate, axis and branches as stout as or stouter than twigs, founded or compressed or angled, with almost black, finely striate bark, up to 9 cm. long, branches distant and short, usually horizontal or somewhat decurved. *Flowers* sessile, densely crowded in heads at the branch ends, each flower subtended by 4 broad, triangular, more or less persistent blunt bracteoles. *Calyx* more or less globose in bud, obconic after anthesis, c. 3–4 mm. long and 4–5 mm. across mouth, lobes 5, broadly and shallowly triangular, rounded or somewhat acute. *Petals* calyptrate. *Stamens* c. 5–6 mm. long, *style* about same length. Immature *fruit* globular or somewhat depressed globular, 5–6 mm. diam., crowned by calyx rim.

Fig. 11. **Eugenia quadribracteata** HENDERSON Del: CHAN YORK CHYE

PENANG: Waterfall, *Curtis s.n.*, undated, TYPE collection, holotype in Herb. Singapore.

JOHORE: Kota Tinggi-Mawai road, *SFN 30986* (*Corner*), frequent in drier parts of swampy forest.

Although Curtis' specimens are fairly complete, they appear not to have been taken up either by King in the "Materials" or by Ridley in his Flora.

The species is a distinct one in the large closely veined leaves and the stout inflorescence with the unusual arrangement of bracteolate flowers. It may be allied to *E. argutata* Koord. & Valet., of which I have seen no material.

Wray 3771, from Upper Perak, alt. 1,000 ft., two fruiting sheets of which are in Herb. Calcutta, may possibly belong here.

Eugenia (§ Syzygium) **cerina** sp. nov. Fig. 12.

E. punctulata King, Mat. F.M.P., No. 12, 122 (1901); Ridl., F.M.P., I. 747; Corner, Wayside Trees of Malaya, p. 502; non F. M. Bailey (1896). *Syzygium incarnatum* Merr. & Perry in Mem. Amer. Acad. Arts & Sci., XVIII, 3, 195 (1939), non Eugenia incarnata *Elm.*

Arbor ad c. 27 m. alta. *Ramuli* teretes vel juniores compressi, cortice desquamante. *Folia* coriacea, obovata, oblanceolata vel interdum oblonga, apice rotundata, retusa, vel breviter et abrupte acuminata, basi sensim vel abrupte attenuata, 2·5–11 cm. longa, 1·5–5 cm. lata, margine recurva, costa media subtus prominente, supra impressa, *nervis primariis* utrinque c. 16 vel pluribus, indistinctis, vena intramarginali tenui conjunctis. *Petiolus* 0·5–1 cm. longus. *Paniculae* terminales vel interdum axillares, laxe ramosae, ad c. 12 cm. longae, ramis et ramulis compressis, striatis. *Flores* sessiles in apice ramulorum conferti. *Calyx* campanulatus vel obconicus, brevistipitatus, c. 2·25–2·5 mm. longus et 2 mm. latus, breviter et obscure 4-dentatus. *Petala* calyptrata. *Stamina* c. 15–30, filamentis complanatis, 0·5–0·75 mm. longis. *Stylus* c. 0·5 mm. longus. *Ovarium* biloculare. *Fructus* oblongo-obovoideus, 1·2–1·4 cm. longus, 7–8 mm. latus, apice complanatus et umbilicatus, umbilico calycis margine brevissimo cincto.

A *tree* up to c. 27 metres tall, fluted at base, or buttressed, the buttresses sometimes up to c. 1·5 metres, or cylindric, or with a few stilt roots. Bark of trunk reddish or reddish orange, rugose in older trees, more or less papery flaky, a thin green layer next to outer layers, then a buff or yellowish fibrous brittle inner layer, wood hard, pale buff.

Twigs terete or the youngest somewhat compressed, bark pale brown to reddish brown or pale greyish brown, thinly papery flaky. *Leaves* coriaceous, obovate, oblanceolate or occasionally oblong, apex rounded, retuse, or with a

short broad point, or abruptly acuminate with acute or blunt acumen, narrowed at base gradually or abruptly, 2·5–11 cm. long, 1·5–5 cm. broad; margins usually recurved when dry, upper surface olivaceous, pale brown or reddish brown to dark brown, usually dull, lower surface usually lighter; midrib depressed above, elevate and keeled below; *primary nerves* usually about 16 pairs but often more, not curving, usually slightly raised above but not conspicuous, more or less raised below, faint and with difficulty distinguishable from secondaries, meeting in a slender intramarginal nerve which is close to the leaf margin and often hidden by the recurved margin; secondaries and reticulations obscure or faint above, sometimes invisible below or sometimes almost as conspicuous as primaries. *Petiole* 0·5–1 cm. long, channelled above, keeled below,

Fig. 12. **Eugenia cerina** HENDERSON Del: CHAN YORK CHYE

Panicles terminal or occasionally from the upper axils, lax, up to c. 12 cm. long, branches spreading, compressed, finely striate with pale brown or brownish grey bark. *Flowers* small, sessile, crowded at ends of the short ultimate branchlets, bracts and bracteoles very small and inconspicuous; buds obovoid, c. 2·75–3·25 mm. long; *calyx* campanulate or obconic, c. 2·25–2·5 mm. long and 2 mm. across mouth, narrowed to a very short stout pseudostalk c. 0·5 mm. long, mouth very obscurely and shallowly 4-toothed; *petals* calyptrate; *stamens* c. 15–30, filaments 0·5–0·75 mm. long, broad and flattened, tapering slightly from base to apex, anthers small, oblong, connective gland small and inconspicuous; *style* c. 0·5 mm. long, narrowly conical; *ovary* 2-celled.

Fruit oblong-obovoid, apex flattened, 1·2–1·4 cm. long and 7–8 mm. wide at widest point, apex deeply and narrowly excavate, with very short calyx rim; pericarp fleshy, 3–4 mm. thick, seed more or less globose, c. 4 mm. diam., testa adhering to it but peeling off easily leaving a thicker inner layer beneath which is a mucilaginous coat; cotyledons more or less equal, opposing faces folded, with the large hypocotyle, which is grooved along one side, lying in the fold and extending to periphery of seed.

PERAK: Blanda Mabok, *Wray 3972*, TYPE collection, holotype in Herb. Singapore. Common in lowland forest from Perak to Singapore.

Distrib: Sumatra, Borneo.

A full explanation of the nomenclatorial problems connected with this species, and the reasons for redescribing it instead of merely giving it a new name will be given in the forthcoming critical account of *Eugenia* referred to in the prefatory note to this paper.

Eugenia (§ Syzygium) **nemestrina** sp. nov. Fig. 13.

Arbor 25–30 m. alta. *Ramuli* crassi, teretes, vel ad nodos plus minusve compressi, cortice laevi vel desquamante. *Folia* coriacea, anguste elliptica ad oblongo-elliptica, 6–11 cm. longa, 2–4·5 cm. lata, apice acuminata deflexa, basi cuneata in petiolum longiter attenuata; pagina inferiore minute nigro-punctata; *nervis primariis* utrinque c. 20–25, tenerrimis, supra inconspicuis vel obscuris, subtus inconspicuis, in venam intramarginalem e margine c. 1 mm. distantem conjunctis; *petiolis* 5–8 mm. longis, rugosis. *Inflorescentiae* corymbosae ad 8 cm. longae et latae, multiramosae. *Flores* vulgo 3 vel interdum 1 in apice ramulorum, sessiles vel pedicellati, pedicellis 2–4 mm. longis, alabastris c. 1·3–1·4 cm. longis. *Calycis* tubus cyathiformis, in stipitem 4–5 mm. longum attenuatus, apice c. 6 mm. latus, post anthesin infundibuliformis, apice c. 7 mm. latus, margine truncatus vel interdum cum dentibus minutissimis. *Petala*

calyptratim decidua. *Stamina* 1–2·5 cm. longa, antheris c. 0·5 mm. longis et 0·4 mm. latis, paullum breviore. *Ovarium* 2-loculare, multiovulatum. *Fructus* plus minusve globosus, c. 1·5 cm. diam., calycis margine undulato c. 2 mm. alto coronatus.

A *tree* 25–30 metres tall, slightly or prominently buttressed-fluted at base to 2 metres from ground. *Bark* rufous brown, fissured or distinctly scaly flaky, inner bark deep purple. *Twigs* stout, terete or more or less compressed at nodes, the youngest with smooth or striate or finely rugose pale brown bark, the older twigs with a pale layer scaling off and leaving scaly flaky red brown bark below.

Fig. 13. **Eugenia nemestrina** HENDERSON Del: CHAN YORK CHYE

Leaves decussate, narrowly elliptic to oblong elliptic, 6–11 cm. long, 2–4·5 cm. broad, coriaceous, in life dull green withering yellow, margins upcurled and apex reflexed, when dry upper surface pale brown or reddish brown, lower surface dull pale brown to whitish brown but not glaucous, apex acuminate and deflected sideways, base cuneate and long narrowed on to petiole; midrib sunk in a narrow channel above, strongly raised and keeled below; *primary nerves* very fine, c. 20–25 pairs, raised above and visible because of their pale colour, or in pale leaves almost invisible, hardly distinguishable from secondaries, fine and raised below, very little more conspicuous than secondaries and sometimes only distinguishable from them by their junction with the intramarginal vein, reticulations slightly thickened and raised; upper surface not punctate, lower minutely black dotted; intramarginal nerve fine, c. 1 mm. from the slightly revolute leaf margin; *petiole* 5–8 mm. long, of the same colour as the leaf and wrinkled.

Inflorescences corymbose, terminal, not exceeding c. 8 cm. long and wide, much branched, the primary branchlets about half as thick as twigs, of the same colour, bark longitudinally wrinkled and somewhat pustulate, the ultimate branchlets compressed and ridged. *Flowers* usually in threes or sometimes solitary at ends of branchlets, sessile or sometimes on pedicels 2–4 mm. long, or the outer two flowers of the triads shortly pedicelled and the central one sessile; buds c. 1·3–1·4 cm. long, including pseudostalk, calyx tube cyathiform, c. 6 mm. across mouth, tapering into a ridged pseudostalk c. 4–5 mm. long; mouth truncate or wavy or occasionally with exceedingly obscure teeth; after anthesis the calyx funnel shaped, c. 7 mm. across mouth. *Petals* calyptrate. *Stamens* numerous, 1–2·5 cm. long, filaments tapering very gradually from base to apex, anthers c. 0·5 mm. long and 0·4 mm. broad, apical gland distinct, dark coloured. *Style* a little shorter than stamens. *Ovary* 2-celled with many ovules in each cell.

Fruit smooth, more or less globular, c. 1·5 cm. diam., crowned by the very conspicuous undulating calyx rim c. 2 mm. high; pericarp 2–3 mm. thick, stripping easily from seed which is left without testa (alcohol material); cotyledons nearly equal, outer surfaces closely rugose, inner faces more or less plane, attached to the hypocotyle by short broad stalks either about the centre or near the periphery.

SINGAPORE: McRitchie Reservoir, *SFN 33590* (*Corner*), TYPE collection, holotype in Herb. Singapore; Selitar, near Nee Soon village, *SFN 37396* (*Corner*), Mandai road, *SFN 37252* (*Corner*).

Calyx pale green, gland dotted, petals white, stamen filaments white with green bases. Flowers smelling as those

of *E. grandis*. Flowers in July, December, January, fruits full grown and falling ripe in October.

It may seem surprising that there are still novelties to be found in the last remaining patches of forest in the island of Singapore, but that such is the case serves to emphasise the difficulties of collecting in tropical forests and to point to the exceeding usefulness of the trained *brok* monkeys (*Macacus nemestrina*) used as collectors by the Singapore Botanic Gardens. Ample material of this species was collected by one of them.

Eugenia (§ Syzygium) **taipingensis** sp. nov. Fig. 14.

Arbor 4·5–6 m. alta, trunco 8–13 cm. diam. *Ramuli* teretes, cortice pallide cano vel ultimi cortice fusco. *Folia* petiolata late ovata vel elliptica, ad c. 6·5 cm. longa et 3·5 cm. lata, apice abrupte acuminata, basi abrupte attenuata,

Fig. 14. **Eugenia taipingensis** HENDERSON Del: CHAN YORK CHYE

nervis primariis utrinque c. 10, tenuibus, utrinque prominulis, in venam marginalem e margine c. 1 mm. distantem conjunctis. *Paniculae* terminales ad c. 6 cm. longae et 4 cm. latae, densiflorae. *Flores* sessiles in apice ramulorum dense dispositi. *Calycis* tubus in alabastro anguste campanulatus, c. 4 mm. longus et 2–2·5 mm. latus, in stipitem c. 2 mm. longum productus, margine subtruncato. *Petala* calyptratim probabiliter decidua, glandulosa. *Stamina* ad c. 6 mm. longa, antherae c. 0·4–0·5 mm. longae, glandula satis conspicua. *Stylus* ad c. 5 mm. longus.

A low *tree* with spreading branches, 4·5–6 m. tall, stem 8–13 cm. diam. (*ex Kunstler*). *Twigs* smooth terete with pale whitey grey or brownish white bark or the youngest twigs with brown bark. *Leaves* coriaceous, broadly ovate or elliptic, sometimes tending to be obovate, up to c. 6·5 cm. long and 3·5 cm. broad, apex abruptly acuminate, acumen c. 1 cm. long, base abruptly narrowed and decurrent on petiole; upper surface drying dull brown or blackish brown, minutely punctate, lower surface usually reddish brown, with very minute and inconspicuous black gland dots, or none; midrib sunk above, raised below and slightly pustulate near base; *primary nerves* about 10 pairs, very slender and almost indistinguishable from secondaries and reticulations, raised and slender below, meeting in a slender and not conspicuous intramarginal nerve c. 1 mm. from margin; *petiole* 2–5 mm. long, black, wrinkled, channelled above.

Inflorescence terminal, paniculate, up to c. 6 cm. long and 4 cm. across, branchlets spreading, slender, angled, with brownish or greyish striate bark. *Flowers* crowded at ends of ultimate branchlets, sessile, bracteoles apparently very small and falling early; *calyx* tube in bud c. 4 mm. long and 2–2·5 mm. across mouth, striate when dry, narrowly campanulate, quickly contracted some way below mouth, then tapering gradually into a pseudostalk c. 2 mm. long, mouth truncate or wavy or at most with very obscure shallow lobes; *petals* probably falling as a calyptra, more or less agglutinated when dry, thick textured with conspicuous gland dots; *stamens* numerous, filaments slender, up to c. 6 mm. long, anthers c. 0·4–0·5 mm. long, connective gland conspicuous; *style* much stouter than filaments, c. 5 mm. long. *Fruit* unknown.

PERAK: Taiping, plains, *Wray 2703*, TYPE collection, holotype in Herb. Singapore; Taiping, within 100 ft., in open jungle, low wet ground, *Kunstler 8379*.

This species was included under *E. oleina* Wight (*E. myrtifolia* Roxb.) by King and presumably by Ridley, but it is very distinct from that species in its broader and more acuminate leaves with the nerves and reticulations raised above, and in its truncate calyx mouth.

Eugenia (§ Syzygium) **flosculifera** sp. nov. Fig. 15.

Arbor c. 40 m. alta. *Ramuli* teretes, laeves, cortice pallide, novelli fusci. *Folia* vulgo plus minusve obovata interdum elliptica vel oblongo-elliptica, ad c. 7 cm. longa et 3·5 cm. lata, apice abrupte acuminata, basi attenuata in petiolum decurrentia; *nervis primariis* utrinque ad c. 8, inter se 5–8 mm. distantibus, supra obscuris, subtus tenuibus sed distinctis, in venam intramarginalem a margine c. 3 mm. distantem conjunctis. *Petioli* ad c. 1 cm. longi. *Inflorescentiae* terminales vel ex axillis foliorum superiorum, paniculatae, ad 9 cm. longae. *Flores* parvi, sessiles, in apice

Fig. 15. **Eugenia flosculifera** HENDERSON Del: CHAN YORK CHYE

ramulorum 2 vel 3, alabastris c. 3 mm. longis. *Calyx* c. 2·5 mm. longus apice c. 1·75 mm. latus, lobis 4 late triangularibus obtusis vel subacutis, incurvatis, c. 1 mm. latis et 0·5 mm. altis, basi in stipitem c. 1 mm. longam attenuatus, supra ovarium abrupte contractus. *Petala* calyptrata. *Stamina* c. 16, 0·5–1 mm. longa, filamentis crassis, antheris plus minusve oblongis, 0·2–0·3 mm. longis, apice glandulosis. *Stylus* c. 0·5 mm. longus. *Ovarium* 2-loculare. *Fructus* late oblongus ad oblongo-obovoideus, ad c. 1·5 cm. longus et 1·5–1·75 cm. latus, apice depressus, umbilico conico 4–5 mm. diam., calycis margine minute coronato; pericarpium crassum, c. 5 mm. *Semen* 1, globosum, depresso-globosum vel obovoideum, cotyledonibus omnino conjunctis, ut pseudomonocotyledoneum.

A *tree* c. 40 metres tall, with steep narrow buttresses to c. 2 metres; crown large, spreading; *bark* light buff, slightly scaly flaky, smooth over large areas, slightly pustulate with scattered 3 mm. lenticels, otherwise entire; inner bark thick, pale brownish yellow with fine longitudinal sclerotic strands; wood pale brownish buff. Twigs rather slender, terete, smooth, bark pale whitey grey to very pale yellowish, somewhat polished, in places finely longitudinally cracked, sometimes the outer thin layer peeling off and showing a pale brown layer below; the very youngest shoots with brownish or reddish bark and often angled or channelled.

Leaves thinly coriaceous, usually obovate, sometimes elliptic or oblong elliptic, up to c. 7 cm. long and 3·5 cm. broad, but usually smaller, apex abruptly acuminate, acumen up to 1 cm. long, base long narrowed and decurrent on petiole; upper surface drying dull olivaceous brown or blackish brown, very minutely and almost invisibly punctate, lower surface paler brown or yellowish brown with rather sparse brownish gland dots; midrib sunk above in a narrow channel, raised below; *primary nerves* up to c. 8 pairs, often fewer, 5–8 mm. distant, hardly visible on upper surface, but if visible, slightly raised, fine and raised on lower surface, meeting in an intramarginal nerve c. 3 mm. from the slightly recurved margin; secondaries and reticulations invisible above, sufficiently distinct below but less conspicuous than primaries, reticulations lax; *petiole* up to c. 1 cm. long, drying dark, wrinkled, often finely glandular pustulate, narrowly channelled above.

Inflorescences terminal or from upper axils, paniculate, terminal panicles often fasciculate, up to 9 cm. long but usually shorter, primary branchlets ascending, up to c. 2 cm. long, secondary branchlets 5–7 mm. long, branchlets slender with brown striate bark sometimes dotted with paler glands. *Flowers* small, sessile or nearly so, in pairs or more usually in threes at branchlet ends, bracts and bracteoles

minute and not persistent; buds c. 3 mm. long. *Calyx* c. 2·5 mm. long, c. 1·75 mm. across lobes, tube brown or black when dry, finely wrinkled, lobes 4, broadly triangular, blunt or subacute, incurved, c. 0·5 mm. high and 1 mm. wide, tube more or less fusiform, suddenly contracted below lobes, swollen about ovary, then gradually narrowed to a pseudostalk c. 1 mm. long; *petals* pale brown when dry, calyptrate. *Stamens* about 16 in a single row on edge of disc, 0·5–1 mm. long, filaments stout, their upper part remaining sharply bent inwards until long after the flower opens; anthers more or less oblong, 0·2–0·3 mm. long, the apical connective gland conspicuous as a dark brown knob. *Style* c. 0·5 mm. long. *Ovary* 2-celled with few ovules in each cell.

Fruit pale shining green when ripe, broadly oblong to oblong obovoid, up to c. 1·5 cm. long and 1·5–1·75 cm. wide at widest point, apex depressed with a conical excavation 4–5 mm. diam., fringed with the minute calyx rim but without stamen or style remains; pericarp firm, green, slightly juicy, c. 5 mm. thick; seed one, globose or more or less depressed globose or obovoid, cotyledons dark blackish brown when ripe, testa thin, papery, loose, pale brown ; cotyledons apparently completely fused, no commissure visible, their centre occupied by an intrusion of ? placental tissue which disappears when seed is fully ripe.

SINGAPORE: Reservoir Jungle, *SFN 36133* (*Corner*), TYPE collection, holotype in Herb. Singapore. Flowers in March.

A very peculiar species, which might better be placed in a new section of the genus, known definitely only from this locality. The size of the tree, the smallness of the flowers and the peculiar seed readily distinguish it from all others.

What appears to be the same or a closely allied species was collected by E. J. H. Corner, *SFN 30481* at Bukit Kajang, Kemaman, alt. 500 ft., but there are some differences in foliage and flower characters, and fruit of the Kemaman plant is not yet known.

Eugenia (§ Syzygium) **pseudoclaviflora** sp. nov. **Fig. 16.**

Arbor 6–7 m. alta. *Ramuli* teretes, ultimi tetragoni. *Folia* petiolata, lanceolata vel oblongo-lanceolata, basi attenuata, apice in acumen longum acutum attenuata, 4–8 cm. longa, 1·25–2·5 cm. lata, in sicco supra virescentia, subtus flavescentia, nervis primariis utrinque c. 10, fere obscuris. *Cymae* axillares, sessiles vel breviter pedicellatae. *Flores* sessiles. *Calycis* tubus in sicco clavatus, parte limboidea cyathiformi, 4-dentata, basi in stipitem brevem attenuatus, ad 12·5 mm. longus. *Petala* calyptratim decidua

Fig. 16. **Eugenia pseudoclaviflora** HENDERSON Del: CHAN YORK CHYE

vel interdum libera. *Stamina* ad 4 mm. longa. *Stylus* ad c. 8 mm. longus. *Ovarium* 3-vel 2-loculare. *Fructus* ignotus.

A *tree* 6–7 metres tall. Two-year old *twigs* slender, terete, with dull blackish brown or reddish brown finely cracked bark; one year old twigs very slender, paler than the older twigs or not.

Leaves 4–8 cm. long, 1·25–2·5 cm. broad, lanceolate or oblong-lanceolate, base long narrowed, apex long acuminate or almost caudate acuminate, acumen acute; upper surface dull, smooth, punctate, drying greenish, lower surface drying yellowish, not gland dotted or punctate, margin somewhat thickened; midrib sunk above in a narrow channel, raised and conspicuous below, otherwise the nervation very indistinct or invisible above, only a little more conspicuous below and then only in young leaves; *primary nerves* c. 10 pairs, spaced, meeting in a very obscure intramarginal nerve close

to the leaf margin, reticulations almost or quite invisible; *petiole* blackish brown, wrinkled, up to c. 5 mm. long.

Cymes short, axillary, condensed, sessile or nearly so, shorter than leaves. *Flowers* sessile. *Calyx* narrowly clavate, the limb slightly cyathiform, the tube long narrowed, contracted at base into a short pseudostalk, slightly ribbed and finely rugulose-pustulate, c. 12·5 mm. long; lobes 4, broadly rounded, shallow, c. 0·4–0·5 mm. high. *Petals* usually calyptrate, the calyptra subpersistent, or the petals occasionally free, also subpersistent. *Stamens* up to 4·5 mm. long, filaments slender, anthers broadly elliptic or ovate, c. 0·5 mm. long and 0·3–0·4 mm. wide, connective gland inconspicuous. *Style* c. 8 mm. long, rather stout, more or less cylindric or very slightly fusiform in lower half, upper half tapering gradually upwards. *Ovary* 3 or 2 celled. *Fruit* unknown.

PAHANG: Track to Gunong Tahan, c. 1,000 ft., on ridge, *SFN 31755* (*Kiah*), TYPE collection, holotype in Herb. Singapore. Mature flowers in July.

The inflorescence of this species is very like that of *E. claviflora* Roxb., but the flowers are shorter and stouter; the foliage resembles that of *E. attenuata* Koord. & Valet., but the inflorescence and flowers differ considerably from that species.

§**Fissicalyx**, sect. nov.

Stamina a tubo calycis supra discum orta; post anthesin tubus calycis in lobas irregulares longitudinaliter fissus.

Calyx in bud c. 2·5 cm. long and 1 cm. broad; primary nerves c. 15 pairs, intramarginal nerve 0·5–0·7 cm. from margin .. .. .. *Symingtoniana.*

Calyx c. 4 cm. × 3 cm.; primary nerves 18–25 pairs, intramarginal nerve 2–3 mm. from margin *Watsoniana.*

Eugenia (§ Fissicalyx) **Symingtoniana** sp. nov. Fig. 17.

Arbor c. 3–13 m. alta. *Ramuli* teretes. *Folia* elliptica ad elliptico-oblonga, interdum oblongo-lanceolata, apice abrupte breviter acuminata vel interdum abrupte caudata, basi cuneata, ad 20 cm. longa et 10 cm. lata; *nervis primariis* utrinque ad c. 15, 0·75–2 cm. distantibus, supra impressis, subtus prominulis, in venam intramarginalem 0·5–0·7 cm. e margine conjunctis; petiolis ad 1 cm. longis. *Flos* sessilis, 1 vel interdum 2. Alabastri *calyx* subglobosus ad obovatus, 2·5 cm. longus et 1 cm. latus, deorsum in stipitem brevem attenuatus; lobis ?4; post anthesin tubo calycis in aliquot lobas irregulares longitudinaliter fisso. *Petala* ?4, libera, orbiculares, c. 5 mm. diam. *Stamina* e tubo calycis supra discum orta, filamentis numerosissimis, c. 1·5 cm. longis. *Stylus* c. 1 cm. longus. *Ovarium* 2-loculare, multiovulatum.

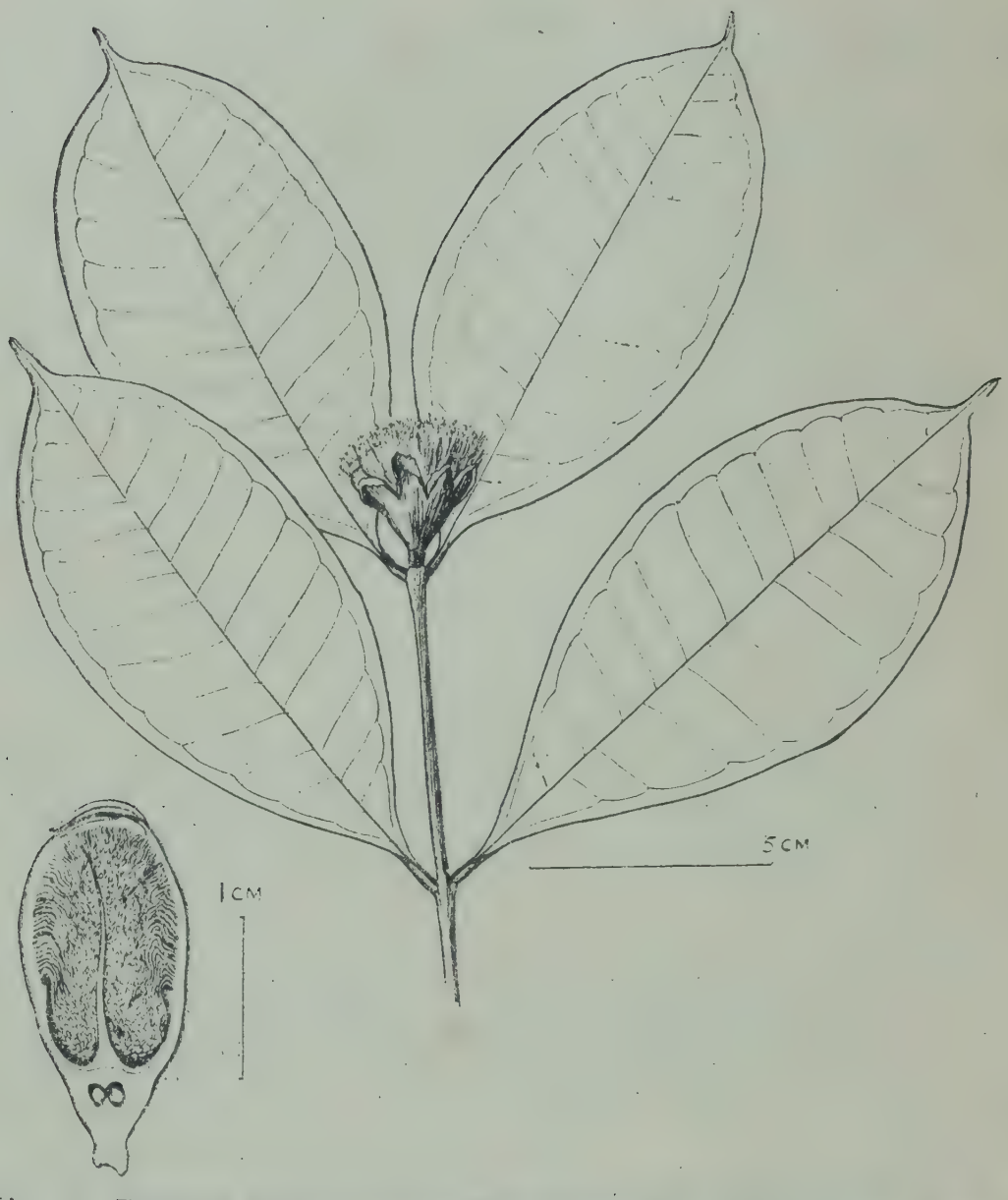


Fig. 17. Eugenia Symingtoniana HENDERSON Del: CHAN YORK CHYE

A *tree* c. 3–13 metres tall. *Twigs* terete, bark drying whitish or greyish white, smooth, with a slight tendency to flaking. *Leaves* elliptic to elliptic oblong, occasionally oblong lanceolate, apex abruptly short acuminate or sometimes abruptly caudate, base cuneate and more or less decurrent on petiole; up to 20 cm. long and 10 cm. broad; *primary nerves* up to about 15 pairs, 0·75–2 cm. distant, impressed above, prominent but not thick below, leaving midrib at an angle of 80–85 degrees and running nearly straight, or more usually curving gently up to the intramarginal nerve, which is 0·5–0·7 cm. from leaf margin, with a much fainter one c. 0·2 cm. from the margin; secondaries and reticulations faint above, easily visible below, usually a well defined secondary between each pair of primaries, reticulations rather lax; upper surface drying fuscous dull or greyish

brown, lower surface a warmer reddish brown; *petiole* stout, drying black, deeply channelled above, up to c. 1 cm. long.

Flowers usually solitary or occasionally in pairs at ends of branches, sessile; *calyx* in bud subglobose to obovoid, c. 2·5 cm. long and 1 cm. wide when mature, more or less campanulate after anthesis, slightly swollen about ovary, constricted at base into a short stout pseudostalk; surface of tube smooth or longitudinally striate when dry; lobes ?4, short, round, gland dotted, but the tube splitting deeply after anthesis into several deep irregular triangular false lobes. *Petals* ?4, free, thin, suborbicular with a short broad claw, c. 5–6 mm. diam., apparently often subpersistent, as are the calyx lobes, and adherent to the apices of the rolled back false calyx lobes. *Disc* lining calyx tube to c. 0·5 cm. above ovary. *Stamens* borne on the whole surface of the calyx tube above disc, the tube being produced c. 1 cm. above disc; filaments very numerous, slender, flattened below and gradually tapering upwards, c. 1·5 cm. long; bases of the fallen stamens giving the inner surface of the rolled back false calyx lobes a tesselate appearance; anthers oblong, c. 0·6–0·7 mm. long, connective gland inconspicuous; *style* c. 1 cm. long or a little longer. *Ovary* 2-celled with many ovules.

PERAK: Sungai Sah, Kledang Saiong, *Forest Dept. FMS 14721*, flowers in March, Malay name *Kelat Jambu;* Sungai Sah, Kinta, *Forest Dept. FMS 28055*, flowers in March, Malay name *Kelat.*

PAHANG: Bukit Goh Forest Reserve, Kuantan, *Forest Dept. FMS 3136*, TYPE collection, holotype in Herbarium of Forest Research Institute, Kepong, flowers in March, Malay name *Kelat Kuning;* Baloh, Kuantan, *Forest Dept. FMS 3719*, flowers in April, Malay name *Kelat Jambu;* Gunong Rokam, Pulau Tioman, 2,500 ft., *SFN 18779* (*Nur*), flowers in May.

A fruiting specimen without flowers has been collected at Sungai Paka, Trengganu, *Forest Dept. FMS 26723*. There is little doubt that it belongs to this species, but the fruits are in poor condition and have not been included in the description of the species. A note upon them follows:

The larger of the two fruits on the sheet is in a rotten and fragmentary condition. Its diameter may have been c. 2·5–3 cm., surface smooth and shining, apex with the remains of the calyx tube and the recurved calyx lobes, forming a crown c. 1·5 cm. diam. The other fruit is much smaller, c. 1·5 cm. diam., oblong globose with a truncate apex completely occupied by the calyx remains.

A collection made at Ulu Brang, Trengganu, c. 800 ft. alt., *SFN 33750* (*Moysey & Kiah*) possibly belongs here, but only immature fruits are available.

Eugenia (§ Fissicalyx) **Watsoniana** sp. nov. Fig. 18.

Arbor ad c. 10 m. alta. *Ramuli* teretes. *Folia* coriacea, anguste elliptica ad oblongo-elliptica, basi cuneata, apice abrupte breveque acuminata vel breve acuta, ad c. 20 cm. longa et 8 cm. lata, *petiolis* c. 1–1·5 cm. longis; *nervis primariis* utrinque 18–25, 0·75–1·5 cm. distantibus, supra impressis, subtus prominulis, in venam intramarginalem 2–3 mm. e margine conjunctis; nervis secundariis supra obscuris, subtus inconspicuis. *Flos* ?solitarius, terminalis, sessilis. *Calycis* tubus campanulatus, deorsum in stipitem

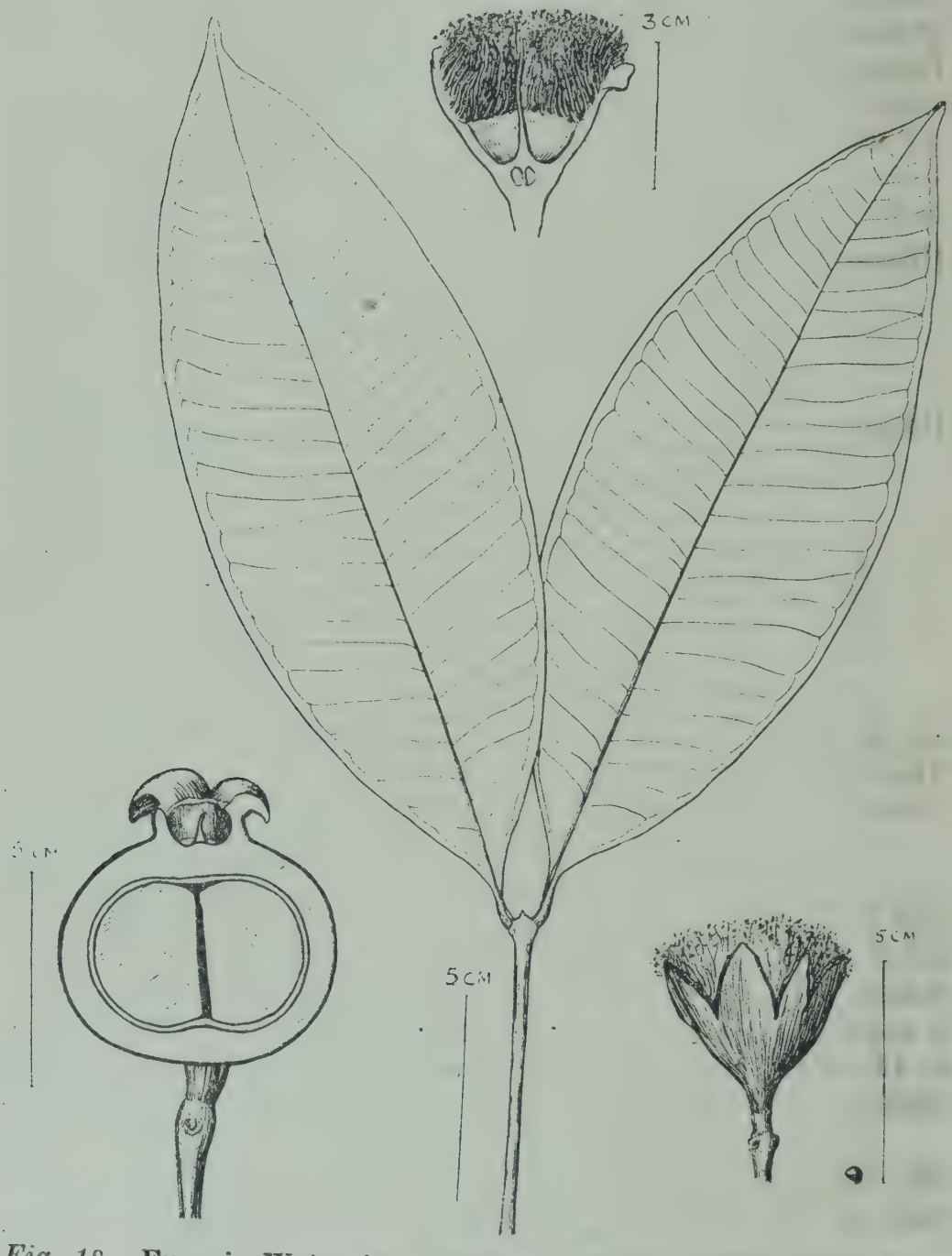


Fig. 18. **Eugenia Watsoniana** HENDERSON Del: CHAN YORK CHYE

brevissimem crassam attenuatus, c. 4 cm. longus et 3 cm. latus, lobis 4, rotundatis; post anthesin tubo calycis in 6–7 lobos irregulares longitudinaliter fisso. *Petala* ignota. *Stamina* numerosissima, e tubo calycis supra discum orta, filamentis 1·5–2 cm. longis. *Stylus* c. 3 cm. longus. *Ovarium* subtus 2-loculare, supra 4-loculare, multiovulatum. *Fructus* globosus vel depresso-globosus, 5–6 cm. diam., margine et lobis crassis reflexis calycis coronatus.

A *tree* up to c. 10 metres tall. *Twigs* terete with pale bark, almost white or greyish white, smooth or slightly flaky. *Leaves* more or less coriaceous, narrowly elliptic to oblong elliptic, base narrowed, apex very abruptly and shortly acuminate or shortly acute, up to c. 20 cm. long and 8 cm. broad, petiole rather stout, usually definitely channelled above, c. 1–1·5 cm. long, the lamina occasionally somewhat decurrent upon it; *primary nerves* 18–25 pairs, 0·75–1·5 cm. apart, more or less impressed above, prominent below but not thick, nearly straight or curving gently up to a well marked intramarginal nerve usually 2–3 mm. from leaf margin; secondaries and reticulations usually almost invisible above, not conspicuous below; upper surface drying dull greyish or fuscous brown, lower surface reddish brown.

Flowers apparently solitary and terminal, sessile, large; *calyx* more or less campanulate, shortly narrowed at base to a very short stout pseudostalk, texture thick and leathery, smooth or faintly longitudinally ribbed, c. 4 cm. long and 3 cm. across in bud, lobes 4, short, broad and rounded, the calyx tube after anthesis splitting into 6 or 7 rather irregular lobes 1–1·5 cm. long; *petals* not seen, probably falling very early; *stamens* very numerous, borne on the surface of the calyx tube above the disc, filaments very slender, c. 1·5–2 cm. long, anthers oblong, c. 0·7 mm. long, connective gland inconspicuous; *style* stouter than filaments, c. 3 cm. long; *ovary* 2-celled below, 4 celled above, multiovulate.

Fruit globose or depressed globose, 5–6 cm. diam., smooth or very faintly vertically ribbed when dry, crowned by the massive remains of the calyx tube 6–9 mm. tall and c. 2 cm. diam., along with the recurved false calyx lobes; pericarp hard and woody when dry, 5–7 mm. thick, testa nearly 1 mm. thick; cotyledons nearly equal, probably sessile, their inner faces apparently almost plane or slightly concave, attached to the hypocotyle near their centres.

SELANGOR: Sungai Lallang Forest Reserve, 1,000 ft., *Forest Dept. FMS 22928*, TYPE collection, holotype in Herbarium of Forest Research Institute, Kepong; "A small straggling tree, 15 ft., in damp stream valley, flr. yellow"; flowers in March; Kanching Forest Reserve,

Forest Dept. FMS 9563, flowers in February, *Forest Dept. FMS 5795*, fruit in January; Rantau Panjang Forest Reserve, *Forest Dept. FMS 595*, fruit in August.

A new section has had to be created for this and the preceding species. The longitudinal splitting of the calyx after the flower opens has not, so far as I can discover, been described in *Eugenia*, nor has the much more peculiar character, that of the stamens borne on the calyx tube above the disc, been found in *Eugenia*, or indeed in any other genus of Myrtaceae.

These two species are obviously very closely allied, but in *E. Symingtoniana* the stamens are borne over a wider area of the calyx tube than in *E. Watsoniana*, the flowers are smaller, and the leaves have fewer primary nerves, with the intramarginal nerve further from the leaf margin.

PUBLICATIONS OF THE BOTANIC GARDENS, SINGAPORE

1. **The Agricultural Bulletin of the Malay Peninsula** (Old Series) nos. 1–9, 1891–1900 (out of print).

2. **The Agricultural Bulletin of the Straits and F.M.S.** (Second Series, monthly issues) Vols. 1–10, 1901–1911. Most numbers are available, price 50 cents each or $5 per volume.

3. **The Gardens Bulletin, Straits Settlements.**

   Vol. 1 nos. 1–5, January to May 1912 (as *Agricultural Bulletin of the Straits and F.M.S., Third Series*). nos. 6–12, December 1913—March 1917 (as *The Gardens Bulletin, S.S.*).

   Vol. 2 nos. 1–12, July 1918—August 1921.

   Vol. 3 nos. 1–12, August 1923—March 1925.

   Vol. 4 nos. 1–12, June 1926—January 1929.

   Vol. 5 nos. 1–12, August 1929—June 1932.

   Vol. 6 nos. 1–15, (issued as parts 1–3) December 1929—October 1930.

   Vol. 7 parts 1–3, September 1932—June 1934.

   Vol. 8 parts 1–4, October 1934—October 1935.

   Vol. 9 parts 1–4, December 1935—March 1938.

   Vol. 10 parts 1 and 2, January 1939—August, 1939.

   Vol. 11 parts 1–3, May 1939—August 1941.

The above former issues of the Gardens Bulletin may be purchased from the Botanic Gardens, Singapore, at $5 per volume or 50 cents per number for vols. 1–5 (Vol. 6, of 15 numbers, $7.50); in some cases two or more numbers were published together. Vols. 7–10 are published at $8 per volume; the prices of parts vary according to their size. The parts are published at irregular intervals, as material is available.

Subscriptions per volume, payable in advance, $8 in Malaya, $8.50 or £1 outside Malaya.

17513—300—9/47